

TMIP Webinar Activity Model Development Experiences

Date: Thursday, June 18, 2009

Time: 2:30pm - 4:30pm (EST)

presenter: John L Bowman, Ph.D.

John_L_Bowman@alum.mit.edu

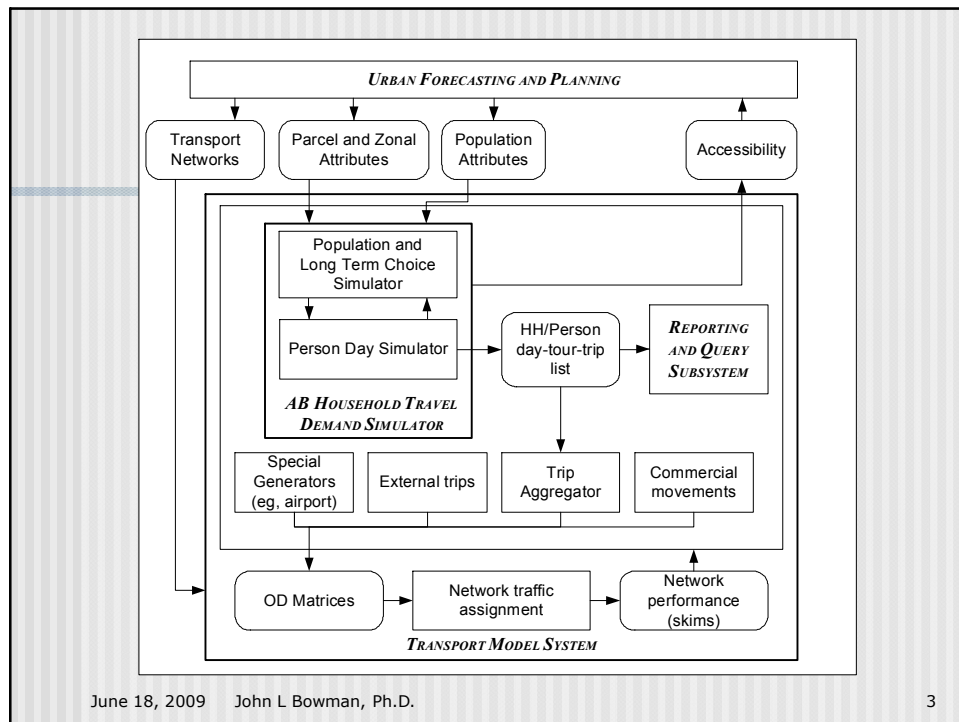
JBowman.net

interactive answers: Mark A. Bradley

Mark_Bradley@cox.net

Outline

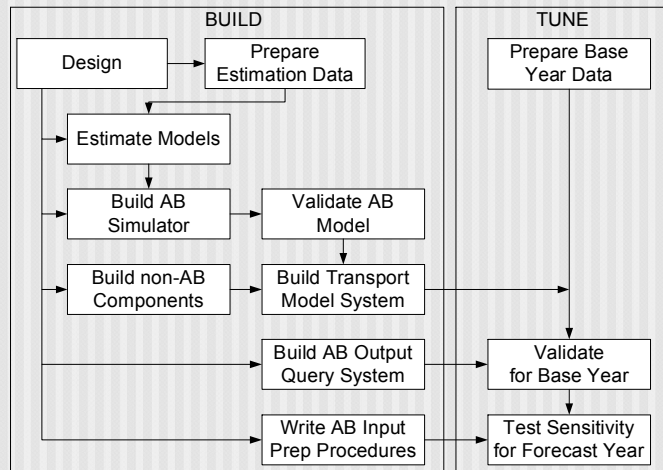
- Activity-Based (AB) Model System
- Development Tasks
- Basic Build Approaches
- Development Roles
- Management Keys to Success
- Postscript—A Few Suggestions



Outline

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The Tasks



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Basic Build Approaches

- Invent
- Adapt
- Adopt

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Outline

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Development Roles

- AB Developer
- Trip-Based Model Expert
- GIS/DB/GUI Expert(s)
- Application Expert

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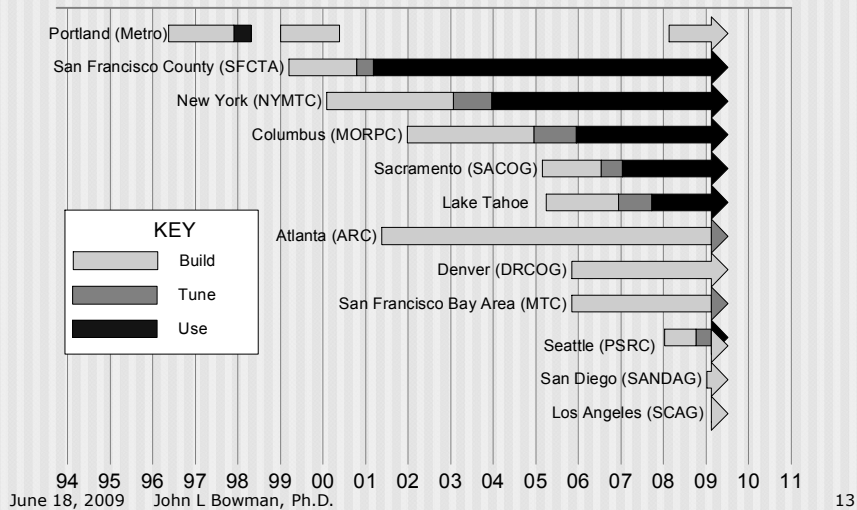
Management Keys to Success

- A sound design
- Capable innovative developers
- Sustained sponsorship

Outline

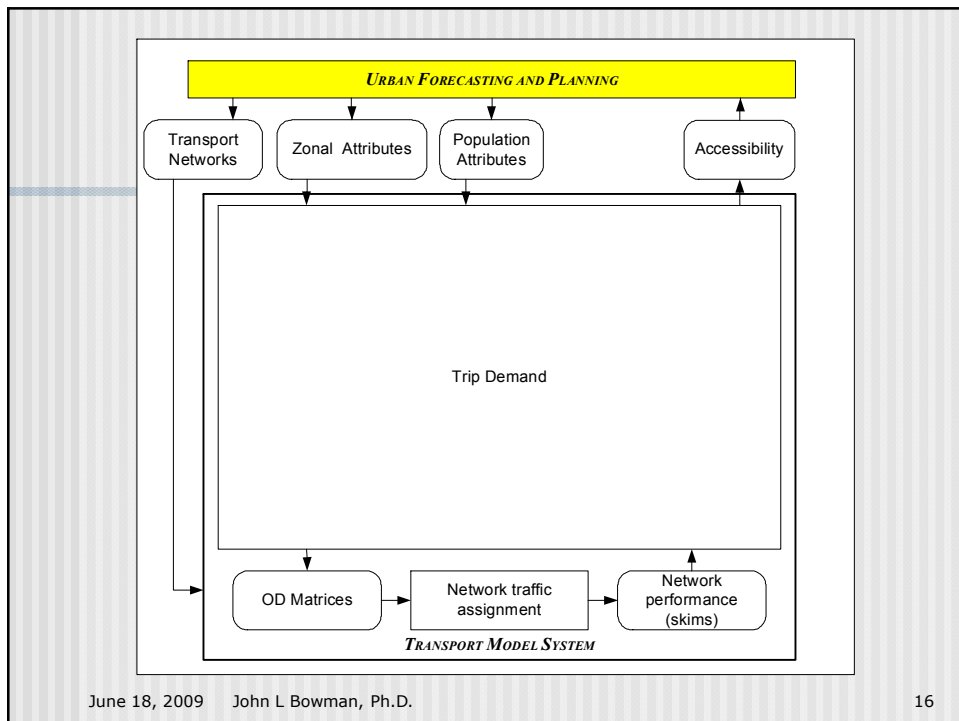
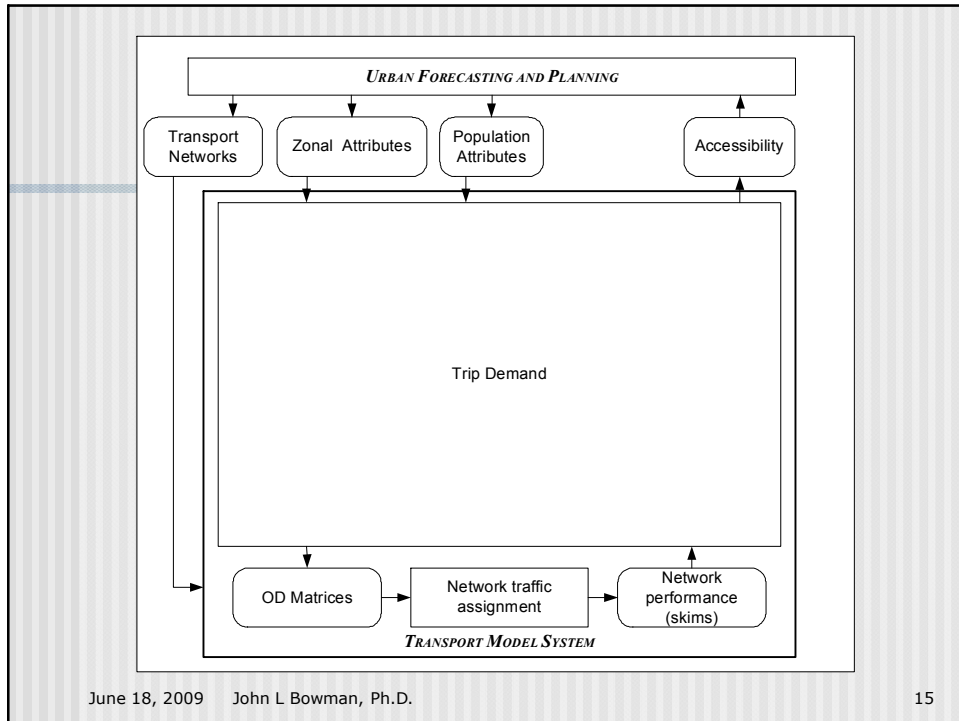
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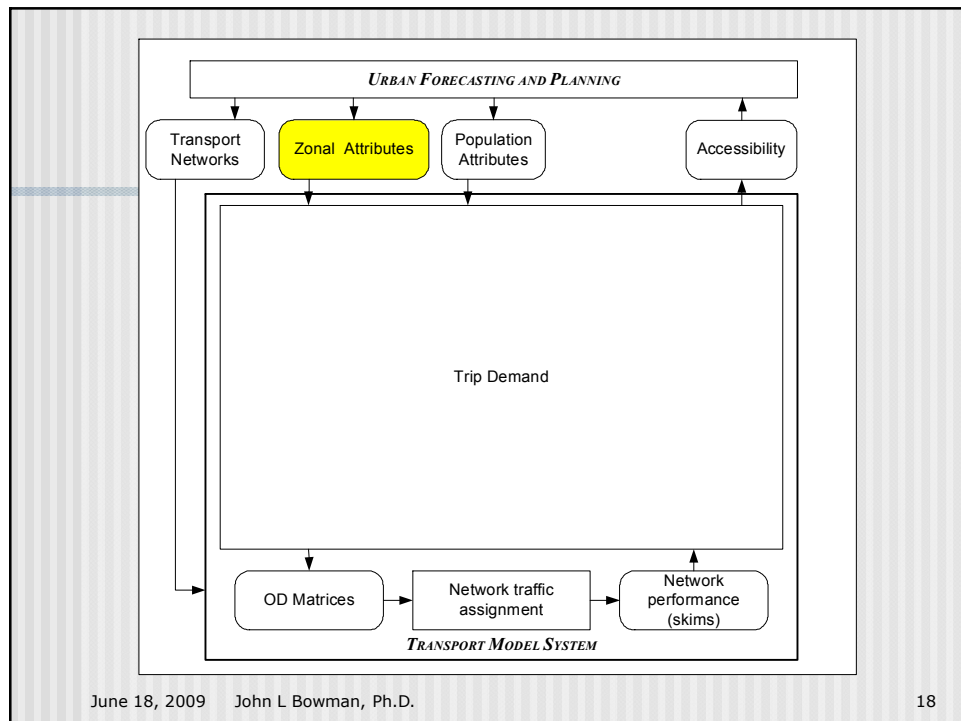
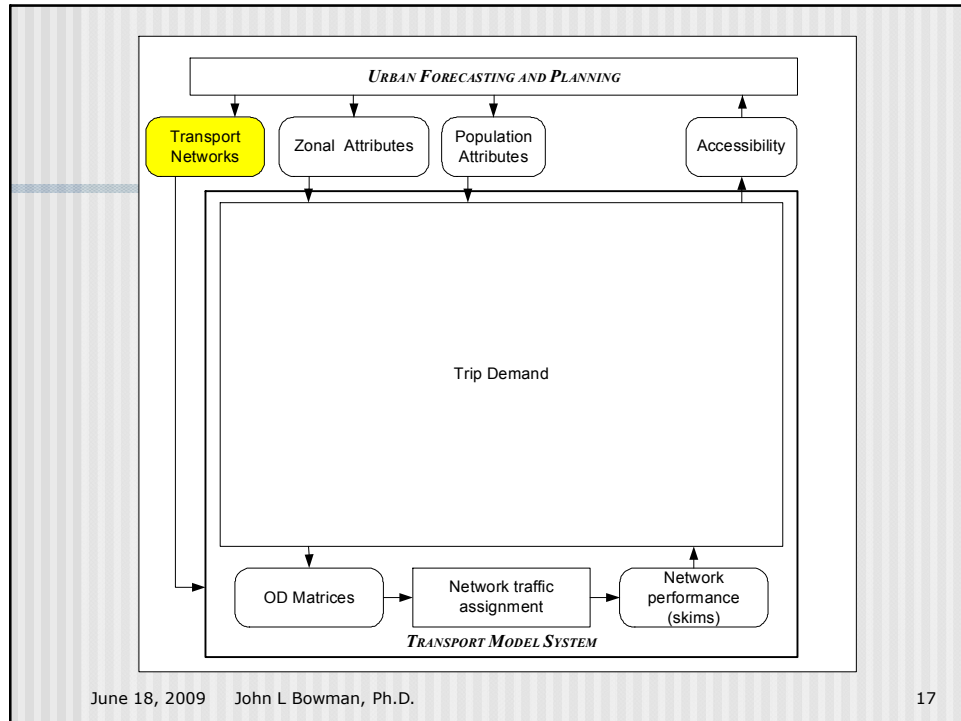
U.S. Projects

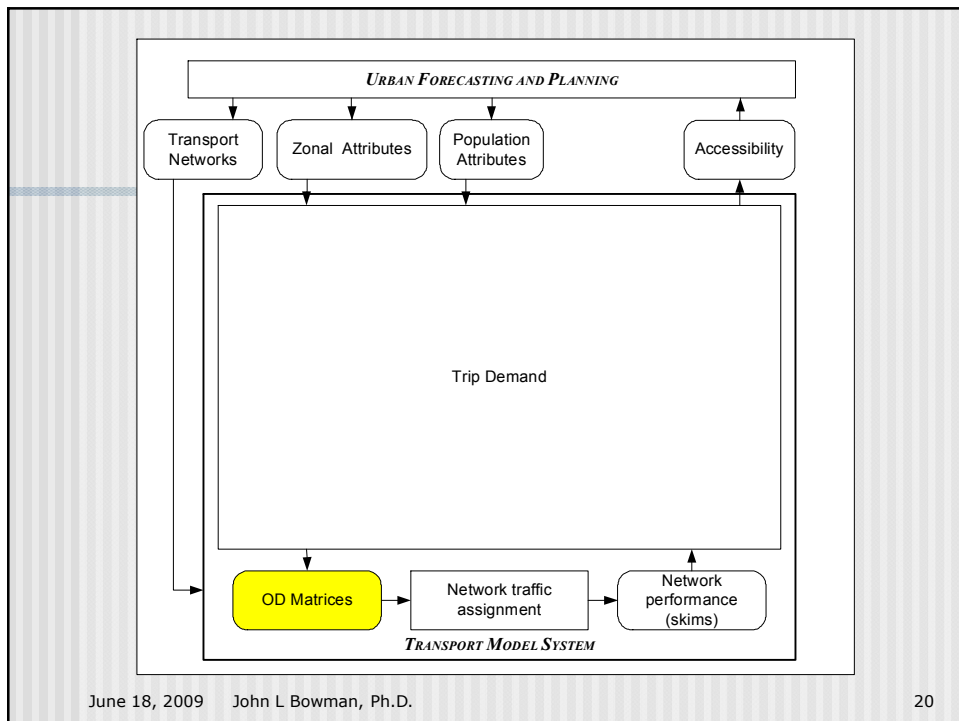
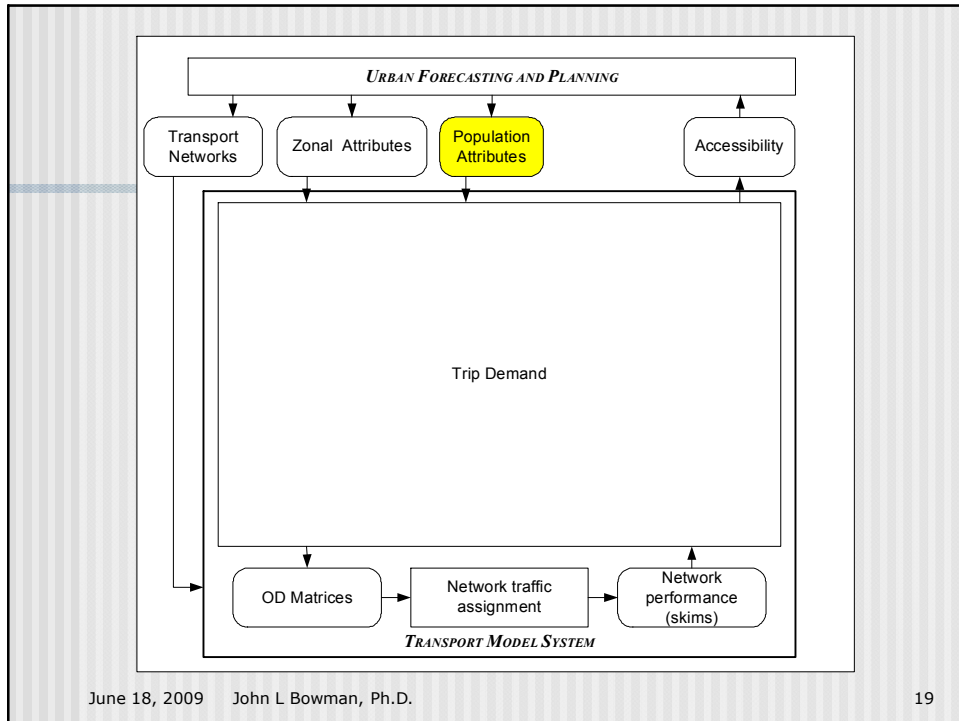


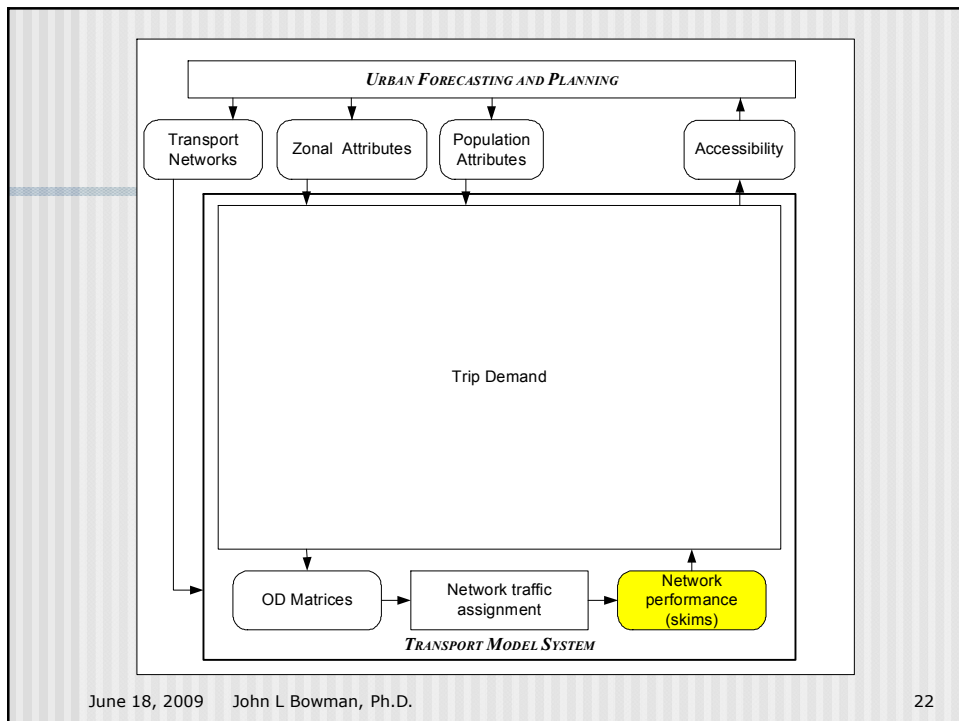
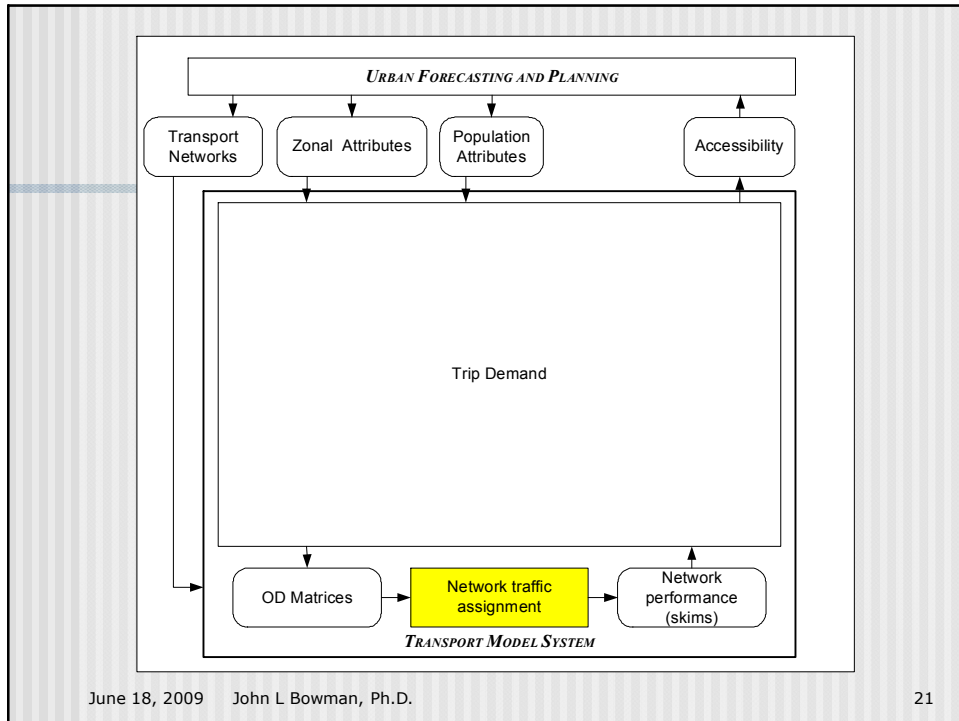
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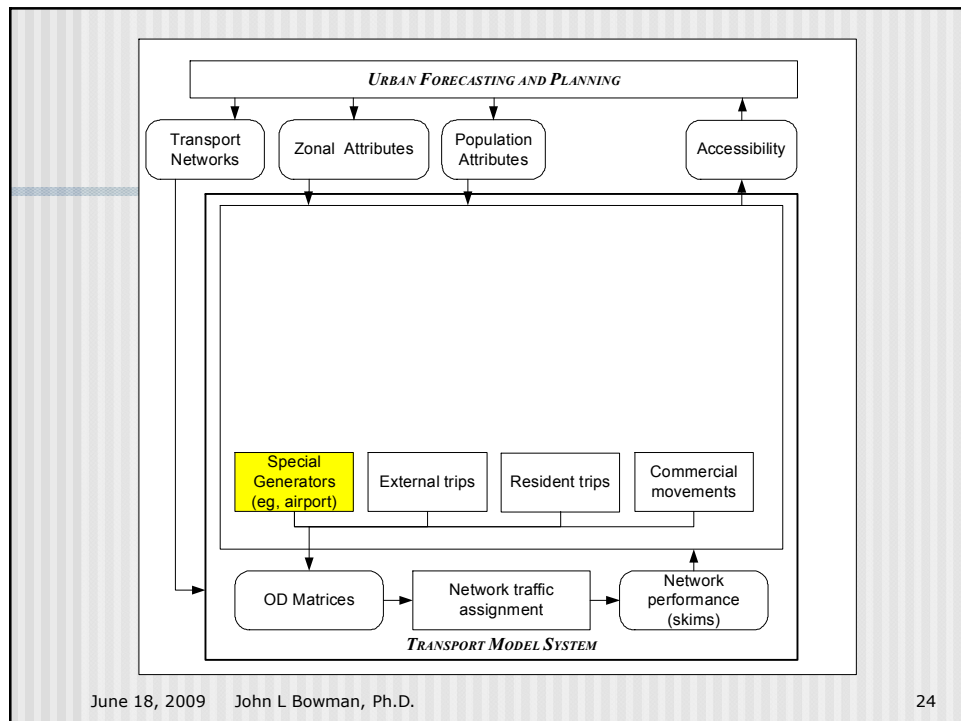
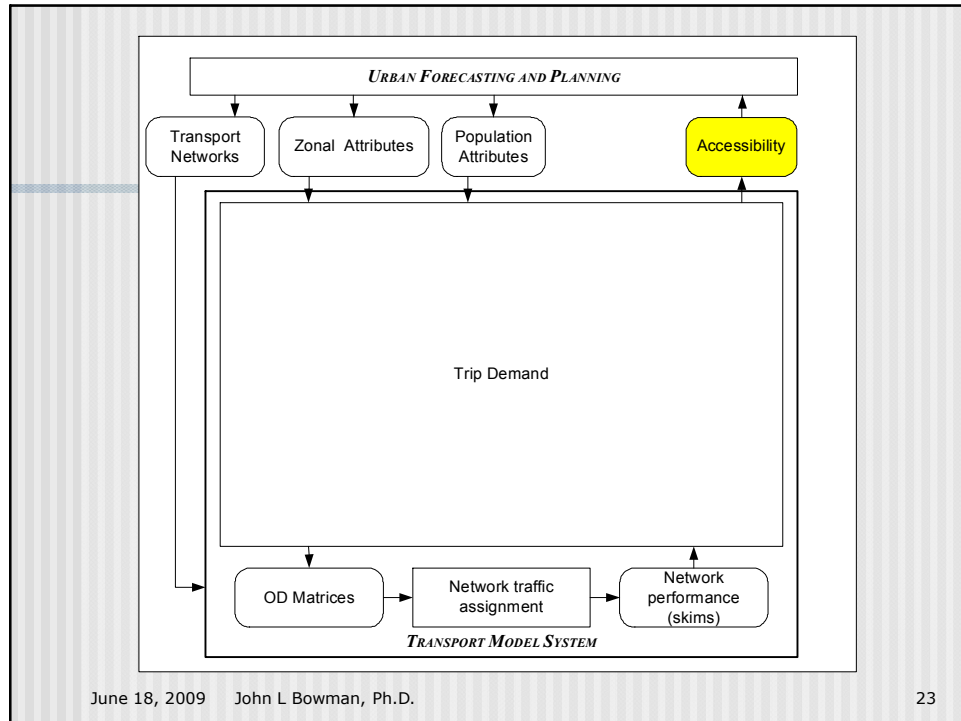
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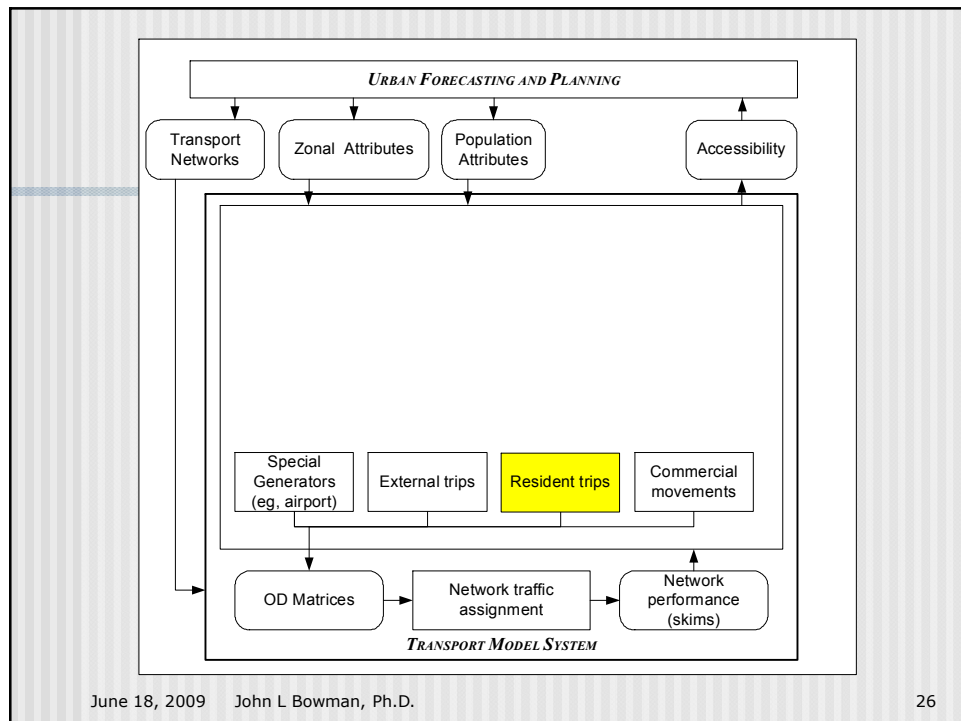
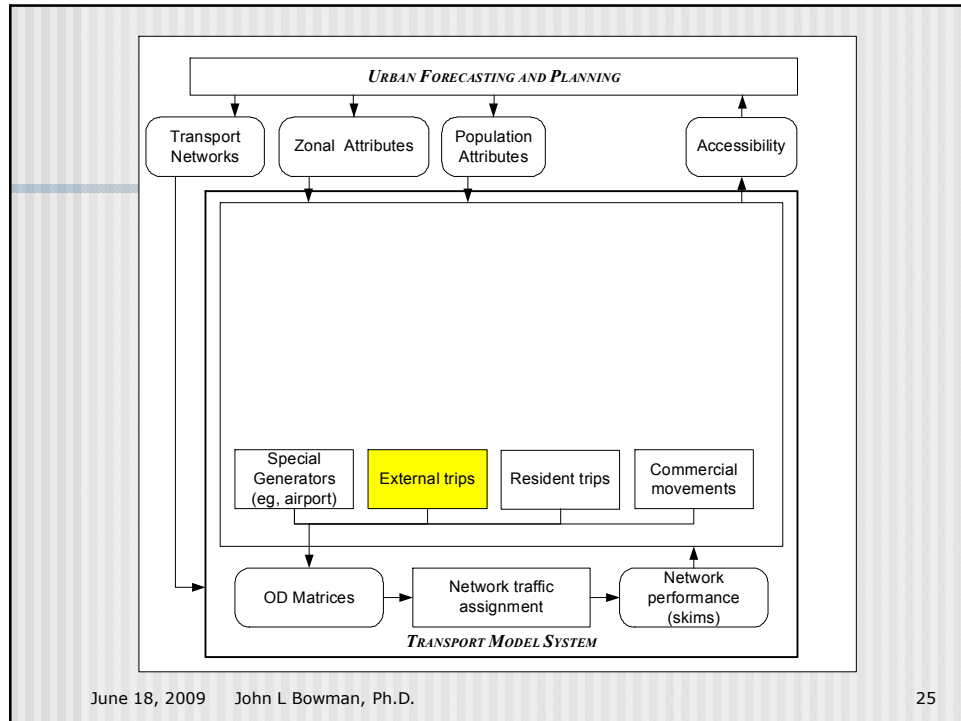


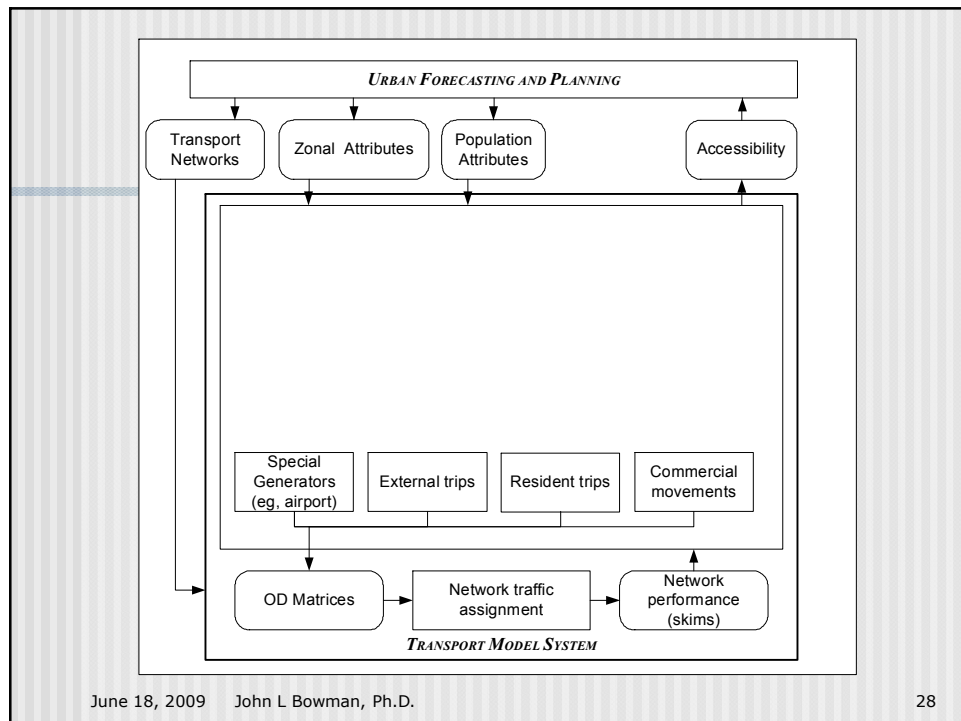
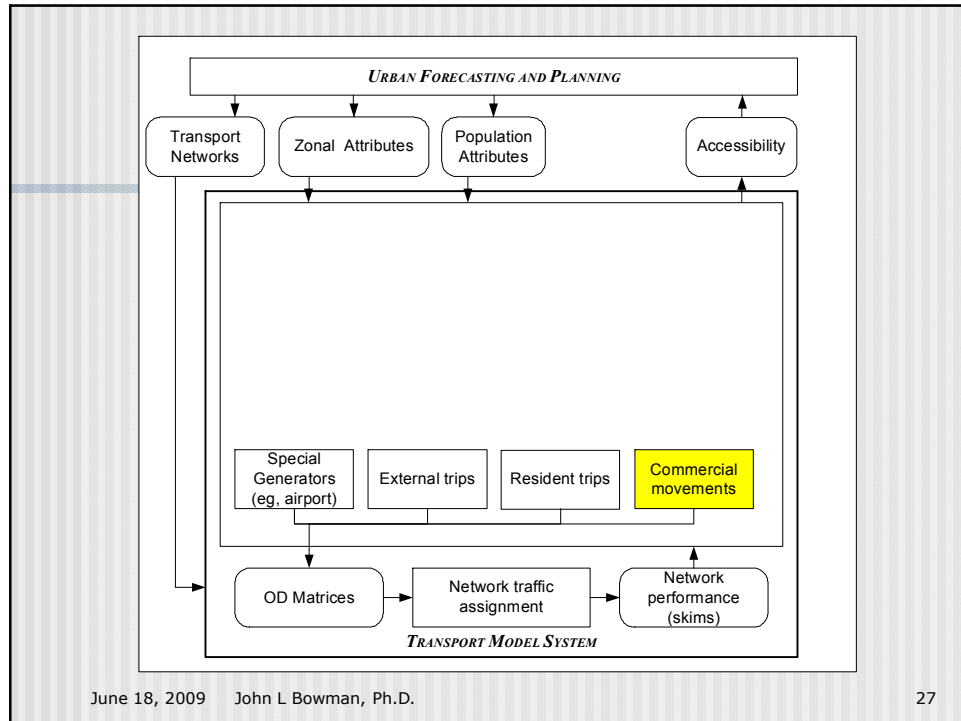


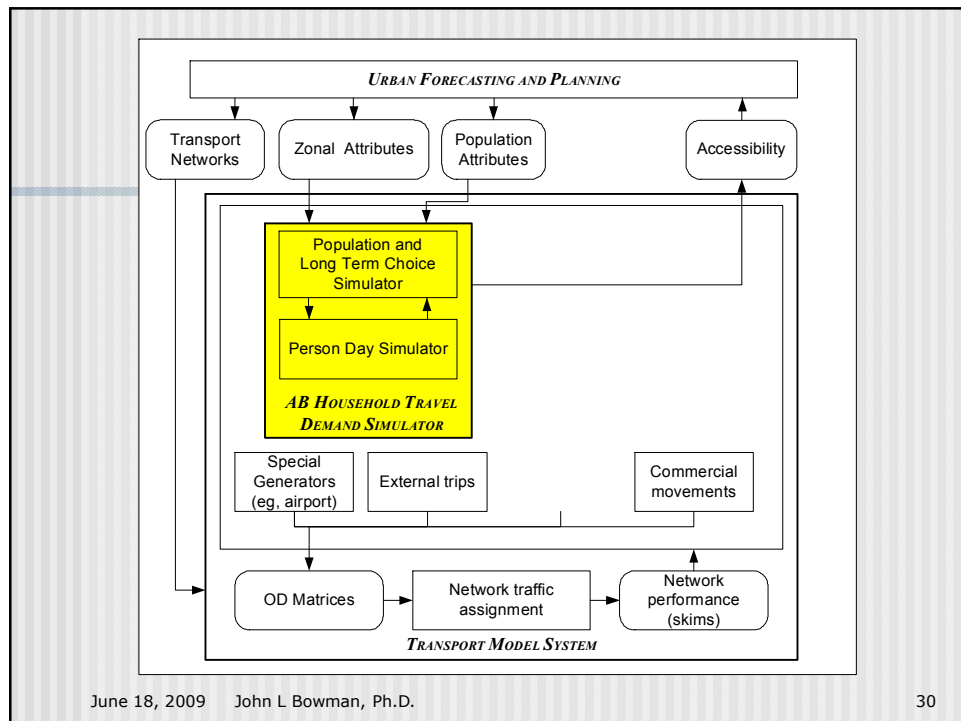
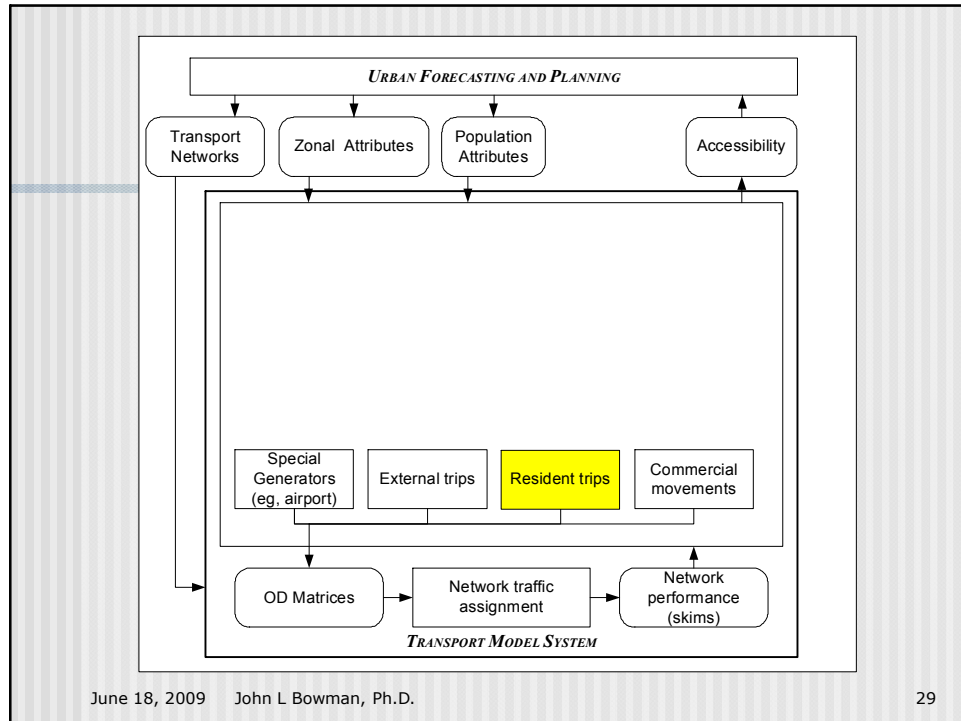


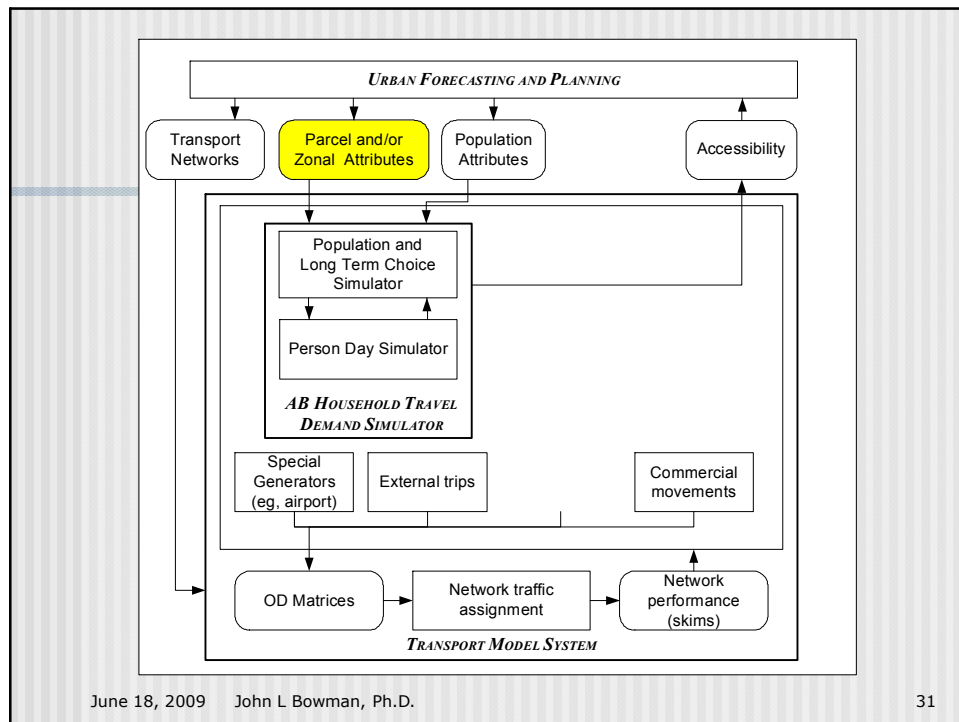






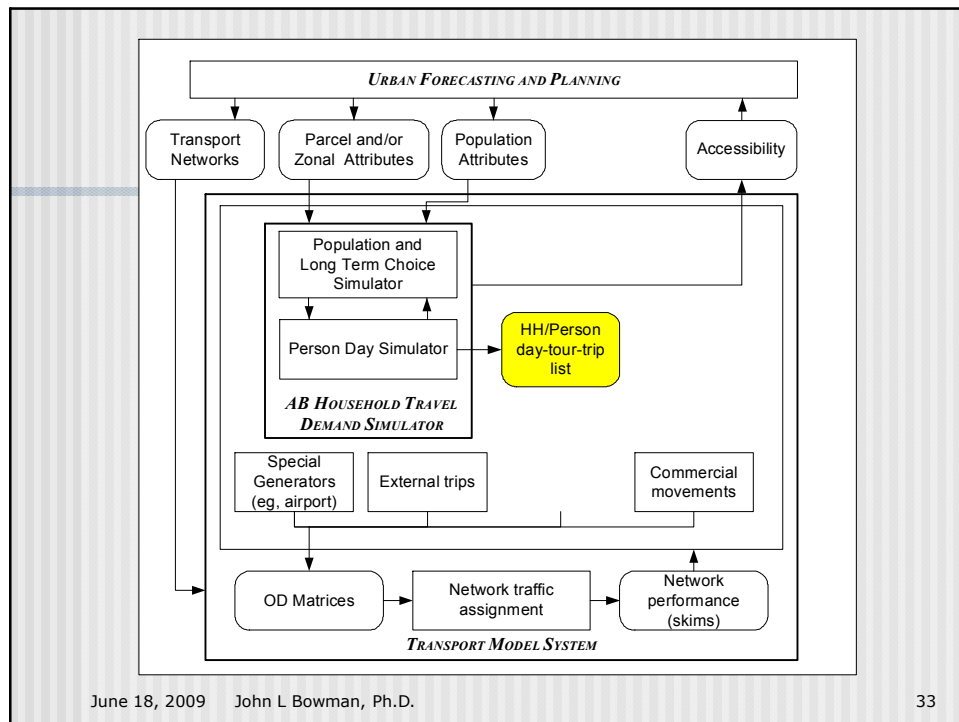






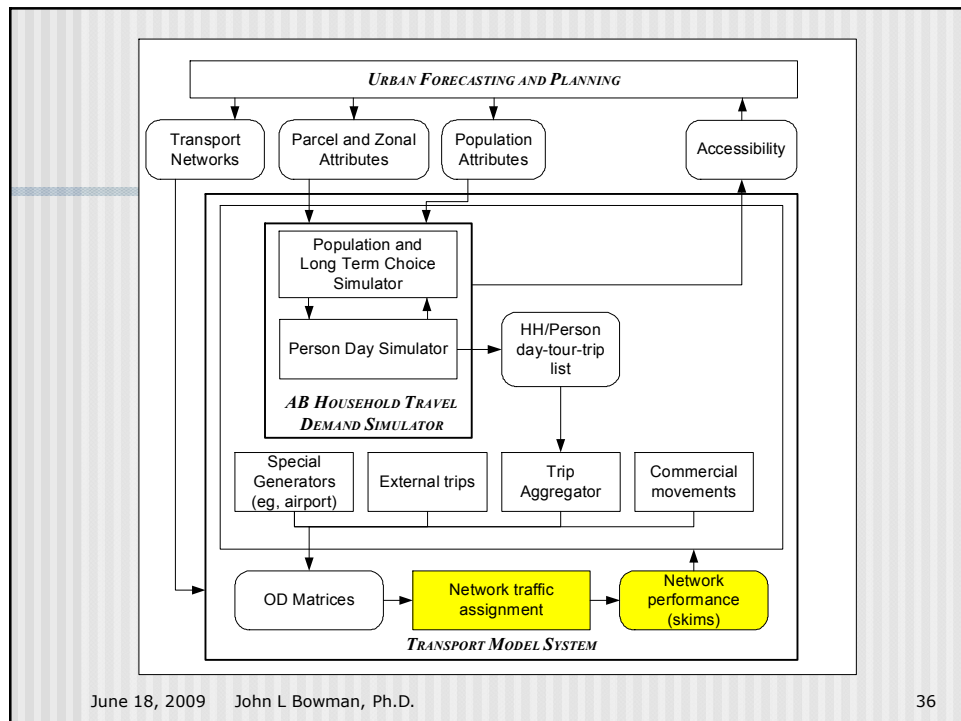
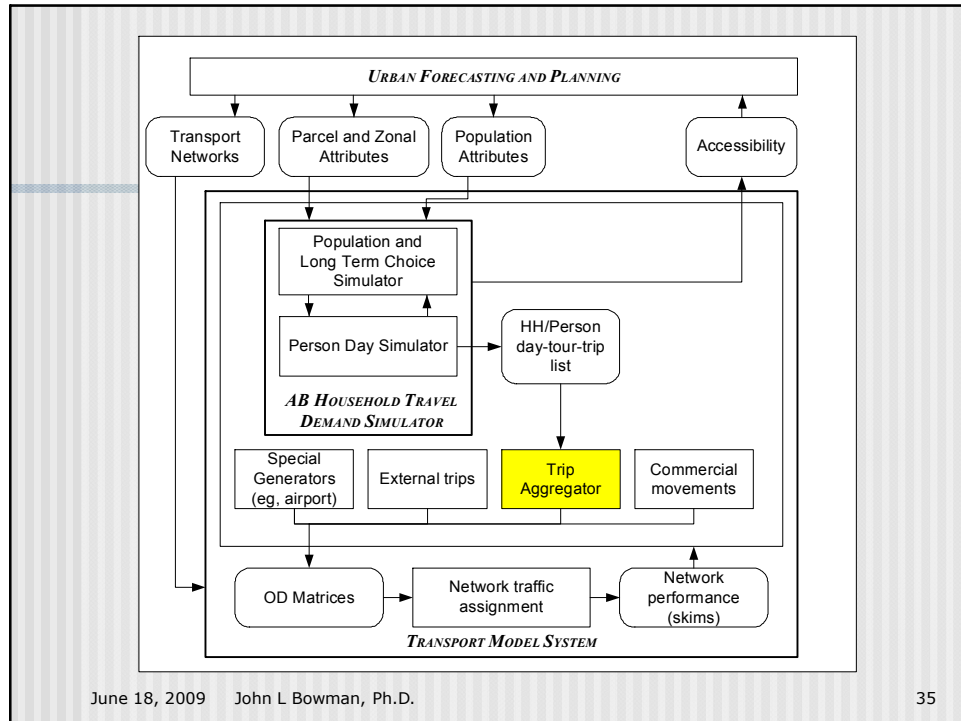
Parcel Attributes

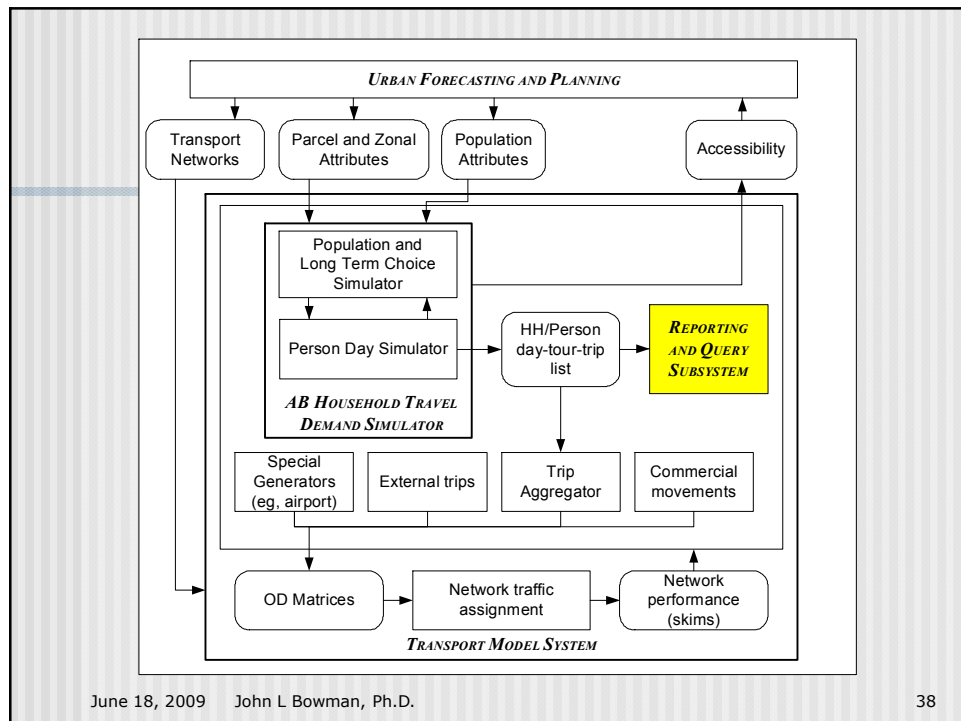
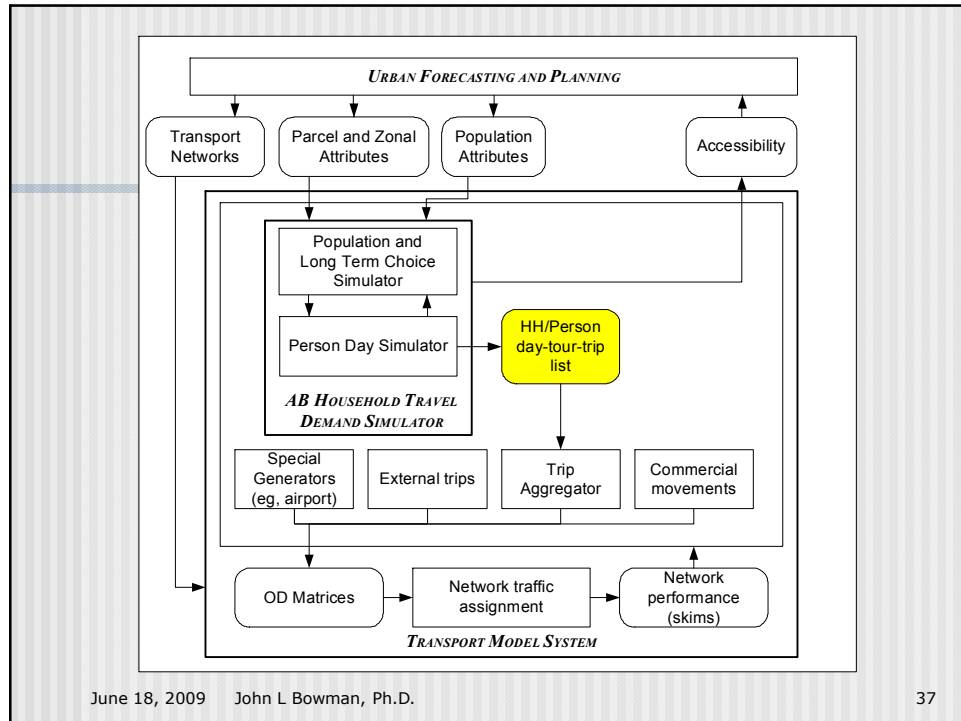
- Within parcel itself
 - Jobs and school enrollment by type
 - Households
 - Housing stock
 - Parking by type
 - Distance to transit by type
- Surrounding the parcel
 - Same as above
 - Intersections by type

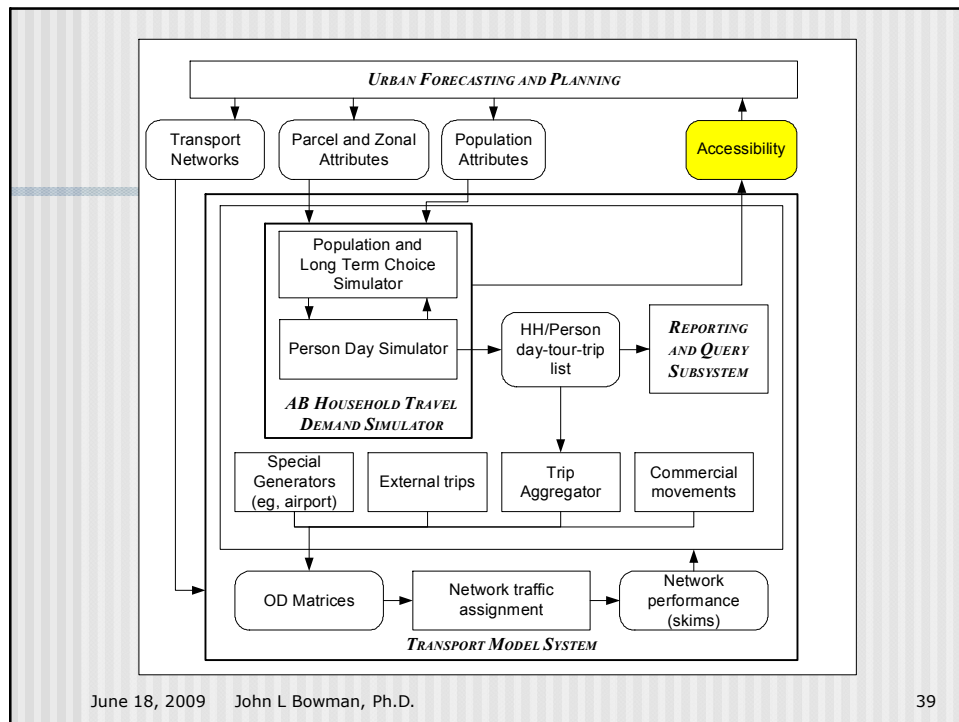


HH/Person/Day/Tour/Trip List

For each...	List includes...
Household	Location, size, vehicles, etc
Person	Age, gender, usual work & school locations, etc
Day	Number of tours and stops
Tour	Purpose, destination, timing, main mode, number of stops
Trip	Origin, destination, origin purpose, destination purpose, mode, departure time, travel time







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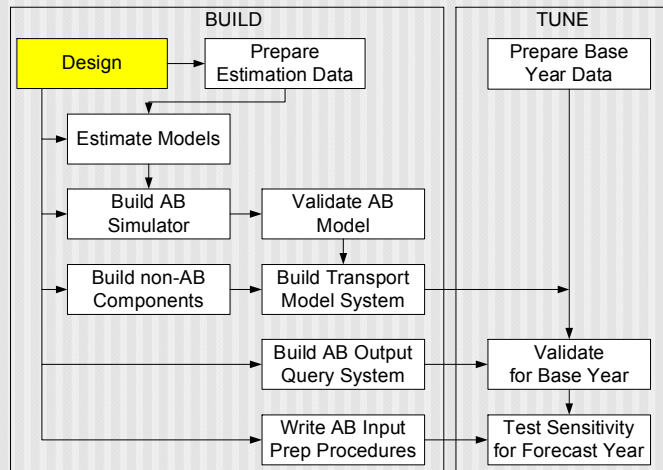
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Design



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Design

- AB Model components
- AB Model Integration
 - Downward (conditionality)
 - Upward (accessibility)
- AB Simulator (software)
- Overall transport model system

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Design

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Design

AB Model components

	Long Term models	
1.0	Population synthesizer	
1.1	Regular work location	Worker
1.2	Regular school location	Student
1.3	Regular mode to work (optional)	Worker
1.4	Transit pass (optional)	Person
1.5	Auto Availability	HH
1.6	Auto type (optional)	Vehicle

Design AB Model components

	Day-level models	
2.1	Household day pattern (optional)	HH-day
2.2	Household joint half-tours (optional)	HH-day
2.3	Joint tours (optional)	HH-day
2.4	Person day pattern	Person-day
2.5	Exact Number of Tours	Person-day

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Design AB Model components

	Tour-level models	
3.1	Tour Destination	Tour
3.2	Work-Based Subtour Generation	Work Tour
3.3	Tour Main Mode	Tour
3.4	Tour vehicle (optional)	Tour
3.5	Tour Time of Day	Tour

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Design

AB Model components

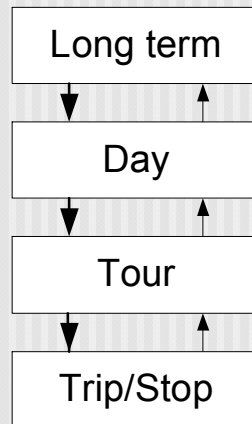
	Trip/stop-level models	
4.1	Intermediate Stop Generation	Half Tour
4.2	Intermediate Stop Location	Trip
4.3	Trip Mode Choice	Trip
4.4	Trip Departure Time	Trip
4.5	Parking location choice (optional)	Trip

Design

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Downward Integration

Lower models take upper outcomes as given

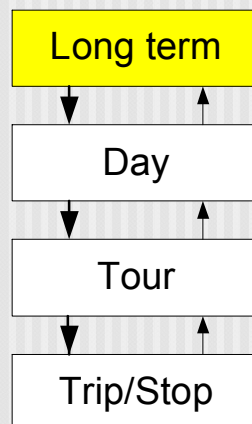


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Downward Integration

Lower models take upper outcomes as given

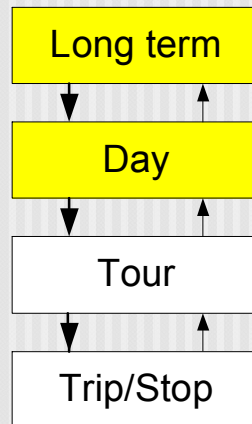


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Downward Integration

Lower models take upper outcomes as given

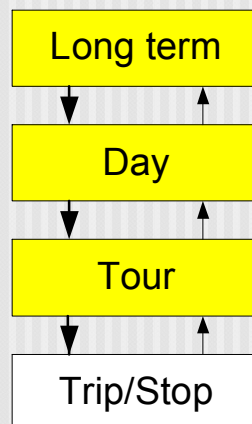


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Downward Integration

Lower models take upper outcomes as given

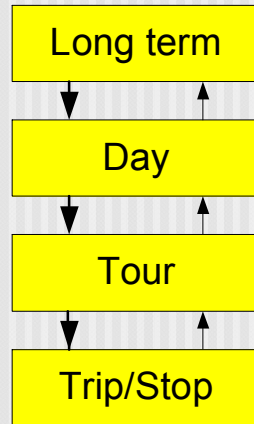


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Downward Integration

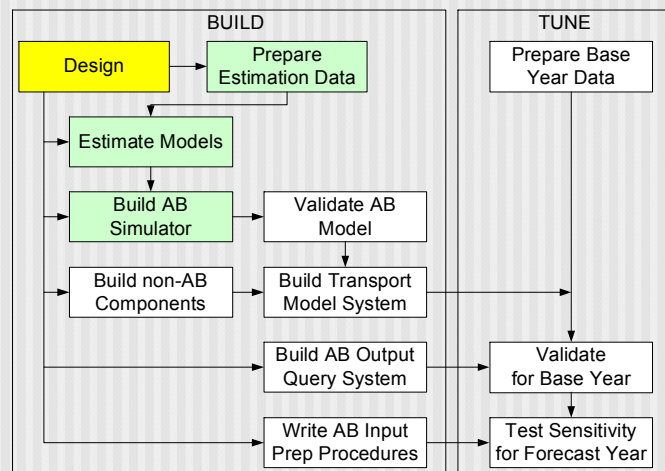
Lower models take upper outcomes as given



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Consistent Design of Downward Integration

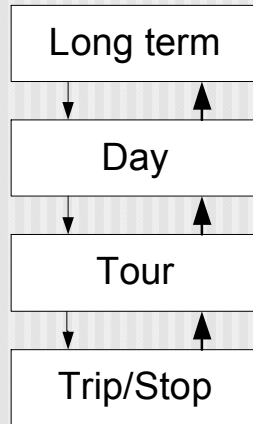


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Upward Integration

Upper models should be sensitive to conditions affecting lower models

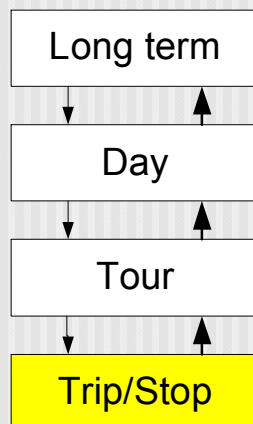


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Upward Integration

Upper models should be sensitive to conditions affecting lower models

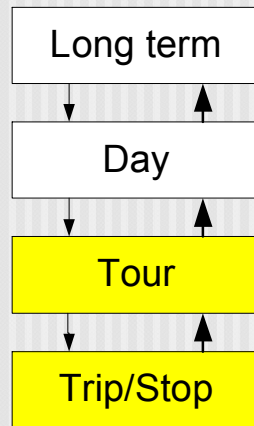


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Upward Integration

Upper models should be sensitive to conditions affecting lower models

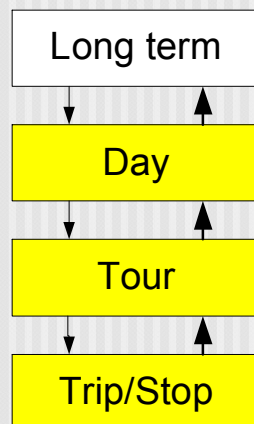


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Upward Integration

Upper models should be sensitive to conditions affecting lower models

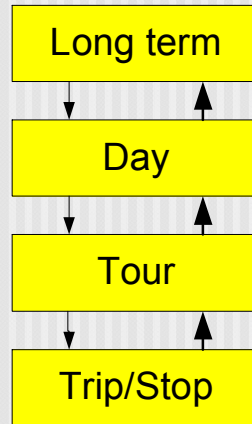


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Upward Integration

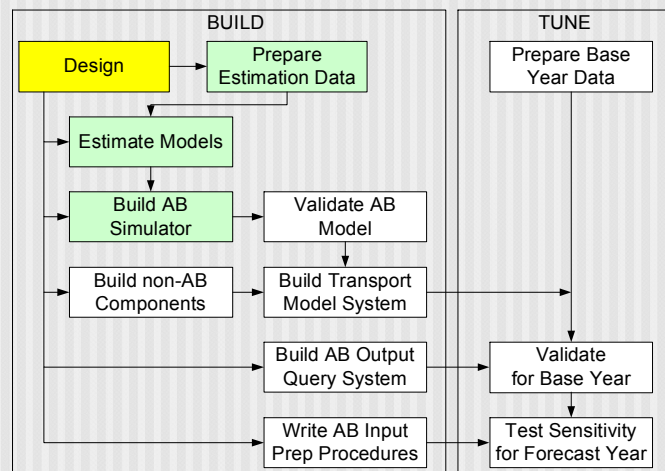
Upper models should be sensitive to conditions affecting lower models



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Consistent Design of Upward Integration



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Design

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 - Downward (conditionality)
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AB Simulator

```
Begin
{Read run controls, model coefficients, TAZ data, LOS matrices,
  population controls, and Parcel data into memory}
{Draw a synthetic household sample if specified}
{Pre-calculate destination sampling probabilities}
{Pre-calculate (or read in) TAZ aggregate accessibility arrays}
{Open other input and output files}
{Main loop on households}
  {Loop on persons in HH}
    {Apply model 1.1 Work Location for workers}
    {Apply model 1.2 School Location for students}
    {Apply model 1.1 Work Location for students}
  {End loop on persons in HH}
{Apply model 1.3 Household Auto Availability }
{Loop on all persons within HH}
  {Apply model 2.1 Activity Pattern (0/1+ tours and 0/1+ stops)
    and model 2.2 Exact Number of Tours for 7 purposes}
  {Count total home-based tours and assign purposes}
  {Initialize tour and stop counters and time window for the person-day before looping on
    tours}
  {If there are tours, loop on home-based tours within person in tour priority sequence,
    with tour priority determined by purpose and person type}
    {Increment number of home-based tours simulated for tour purpose (including
      current)}
  {Apply model 3.1 Tour destination}
```

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Design

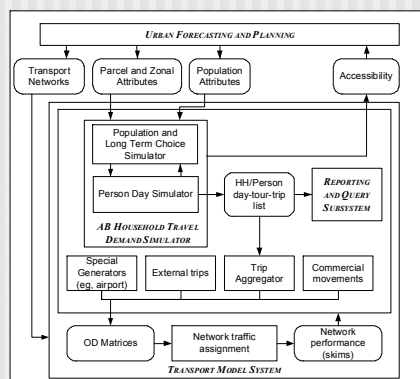
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Design of overall transport model system

- Equilibration
- Performance



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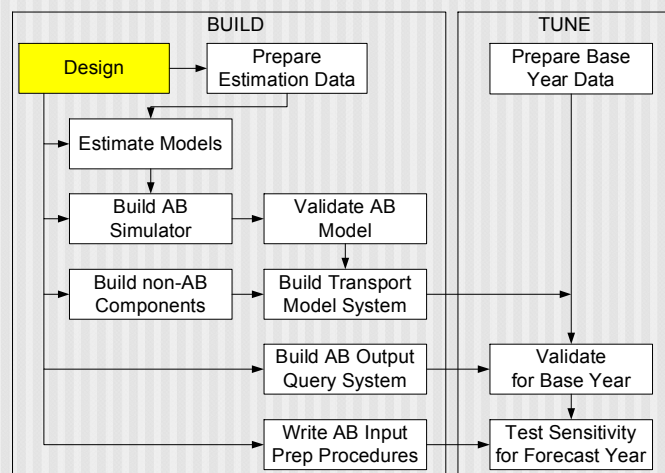
AB Model Design Issues

- Differences among existing models
 - Parcel data
 - Intra-household interactions
- Innovative features
 - Parking
 - Vehicles
 - Pricing
 - Transit
 - Other?

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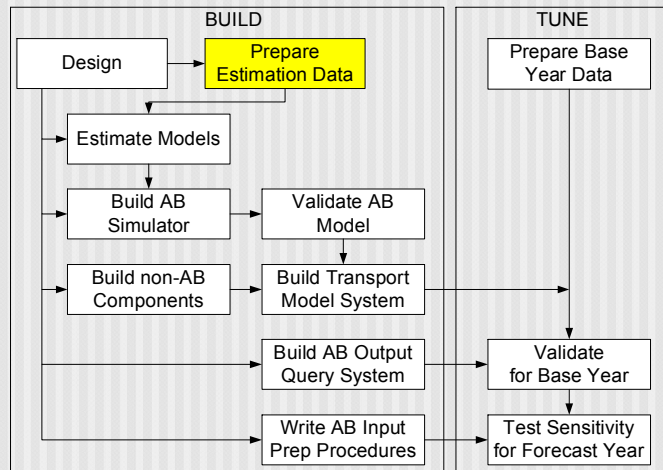
Design



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Prepare Estimation Data



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Prepare Estimation Data

- Household survey data
- LOS data (skims)
- Zonal/parcel data

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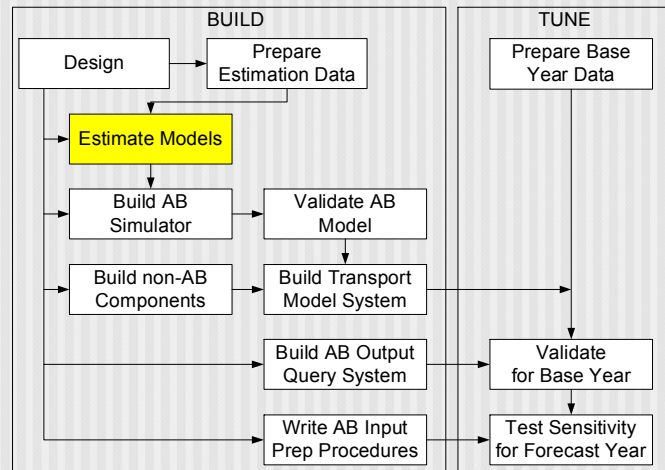
Prepare Estimation Data

- Household survey data
- LOS data (skims)
- Zonal/parcel data

Prepare Estimation Data

- Household survey data
- LOS data (skims)
- Zonal/parcel data
 - Employment
 - School enrollment
 - Housing units
 - Network attributes

Estimate Models



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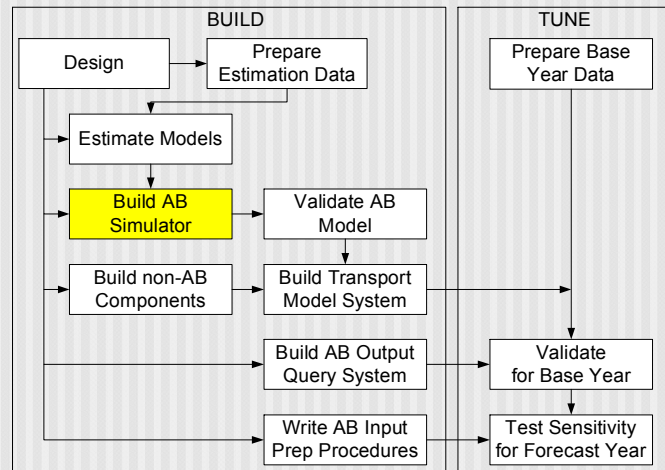
Estimate Models

- Specify
- Estimate
- Test

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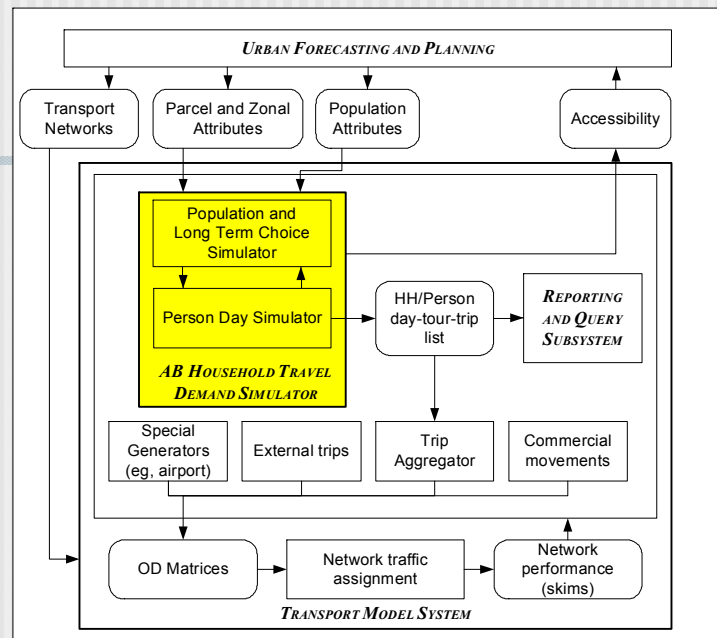
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Build AB Simulator



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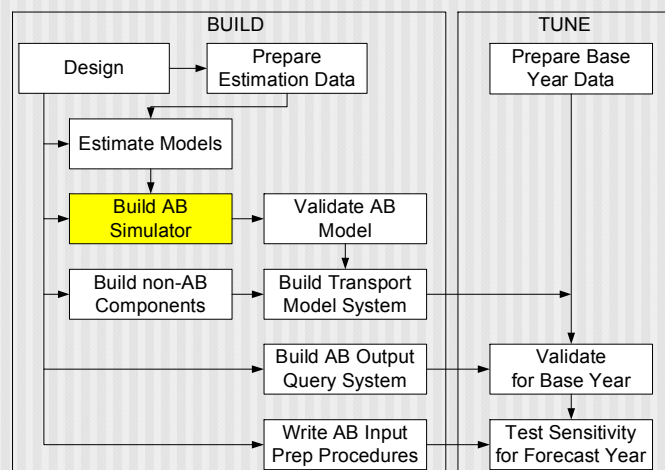
Build AB Simulator

- Creates synthetic population
- Applies all models
- Constructs detailed one-day itinerary for each person

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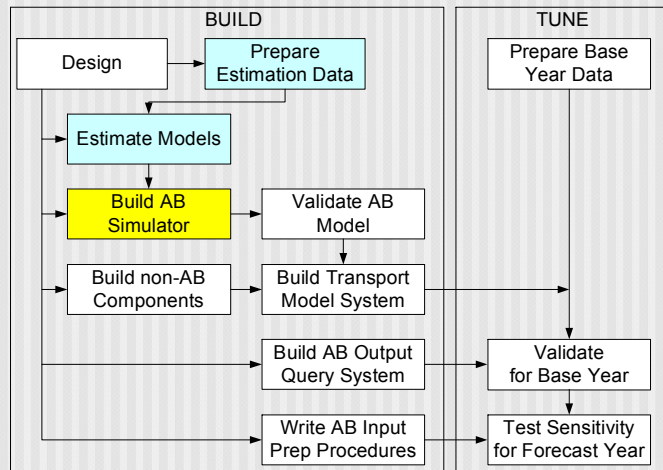
Build AB Simulator



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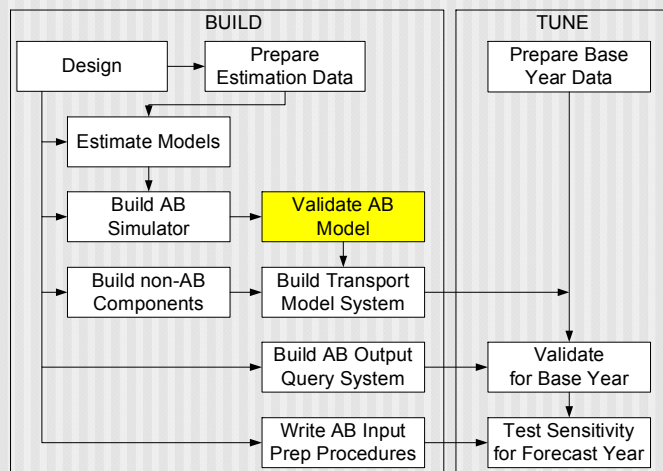
Build AB Simulator



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Validate AB Model



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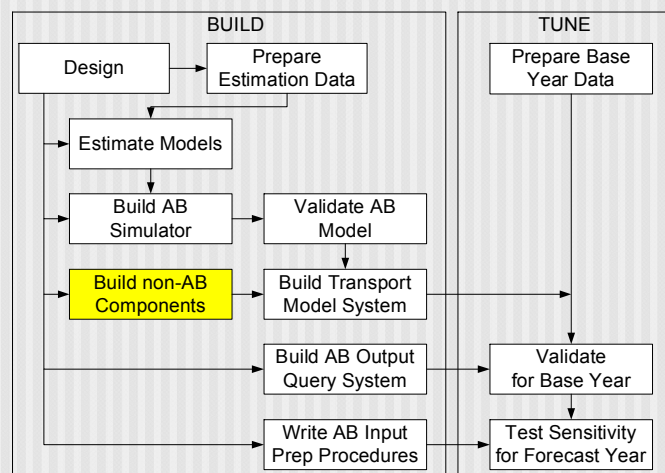
Validate AB Model

- Compare results to expanded HH survey
- Calibrate constants
- Re-estimate if needed
- Debug AB simulator

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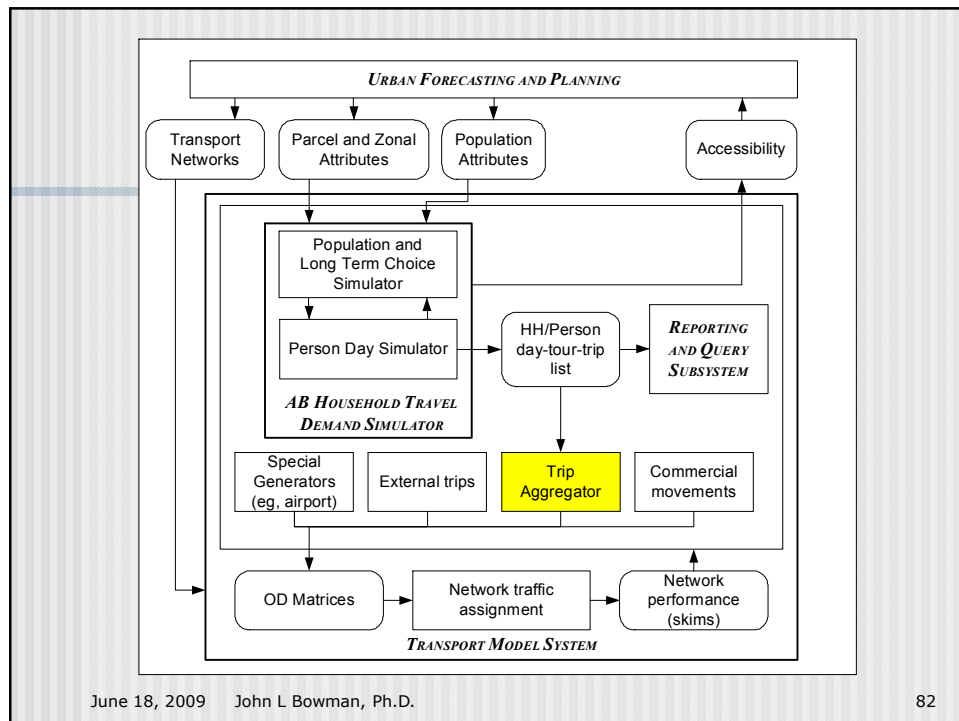
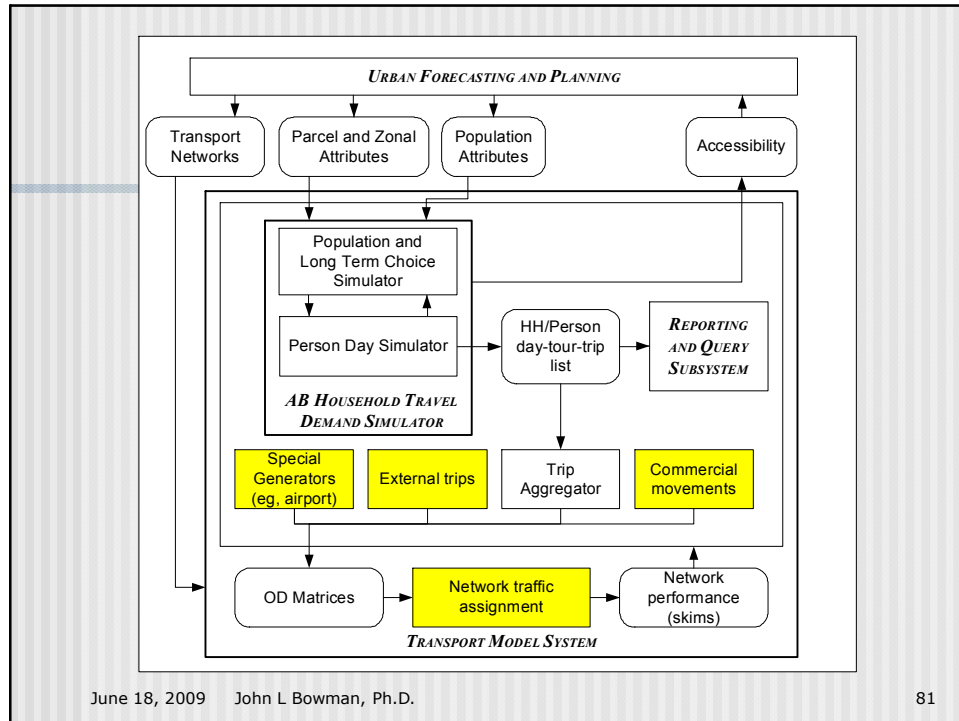
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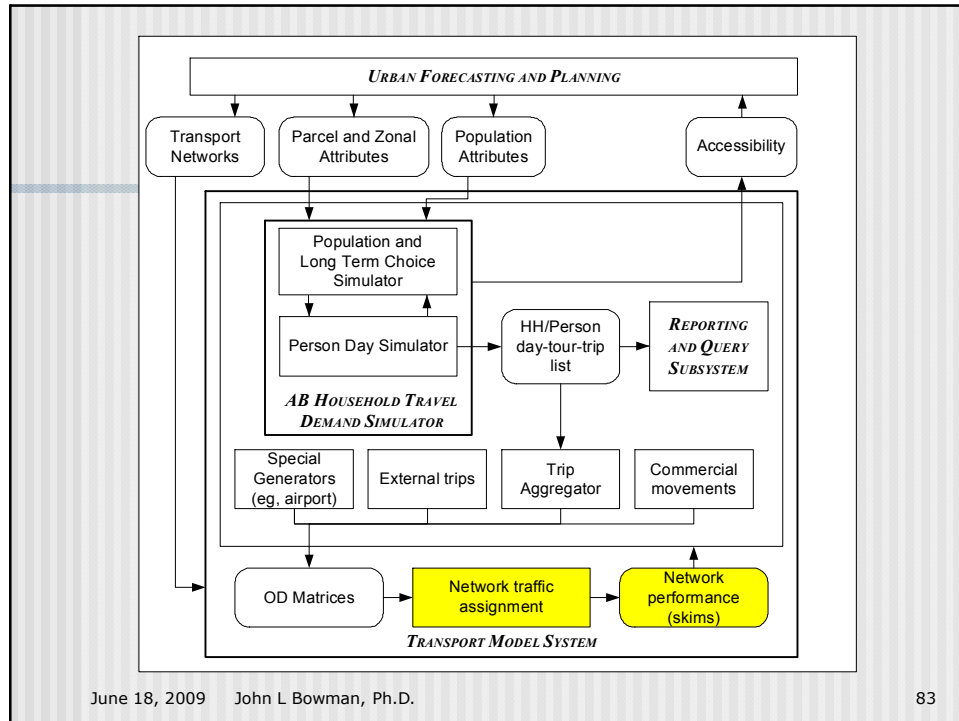
Build Non-AB Components



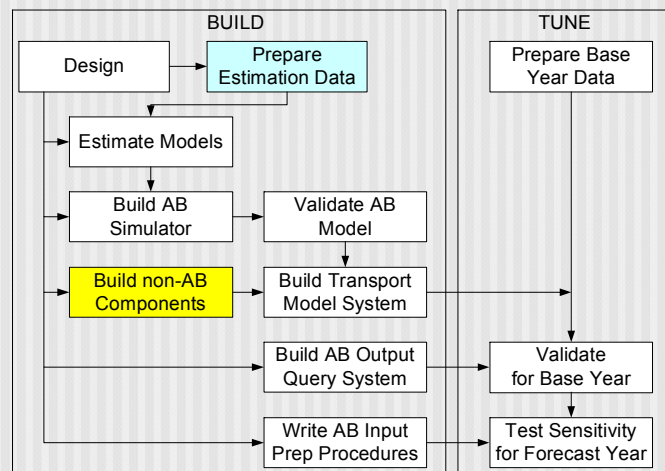
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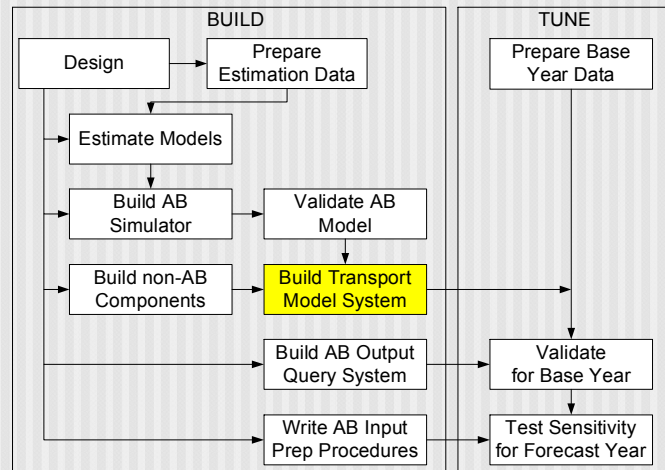




Build Non-AB Components

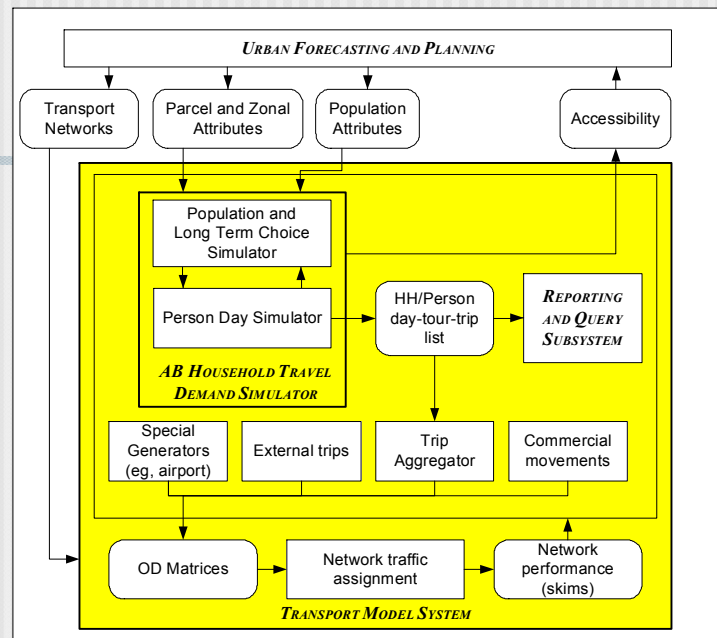


Build Transport Model System



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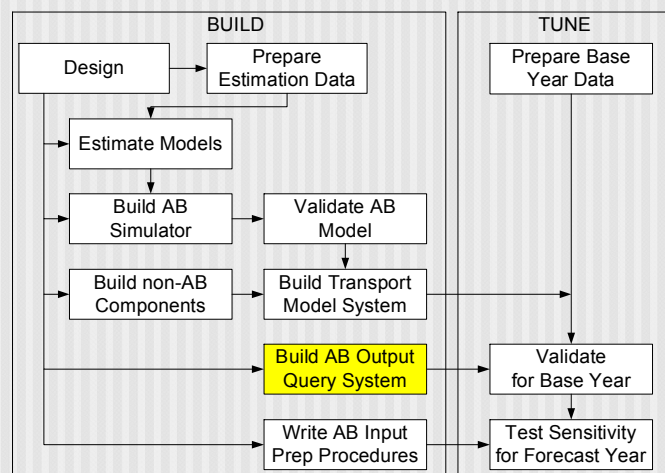
Build Transport Model System

- Install hardware if needed
- Assemble scripts
 - Non-AB components
 - AB simulator
 - Iteration scheme
- Test and tune
 - Convergence
 - Performance

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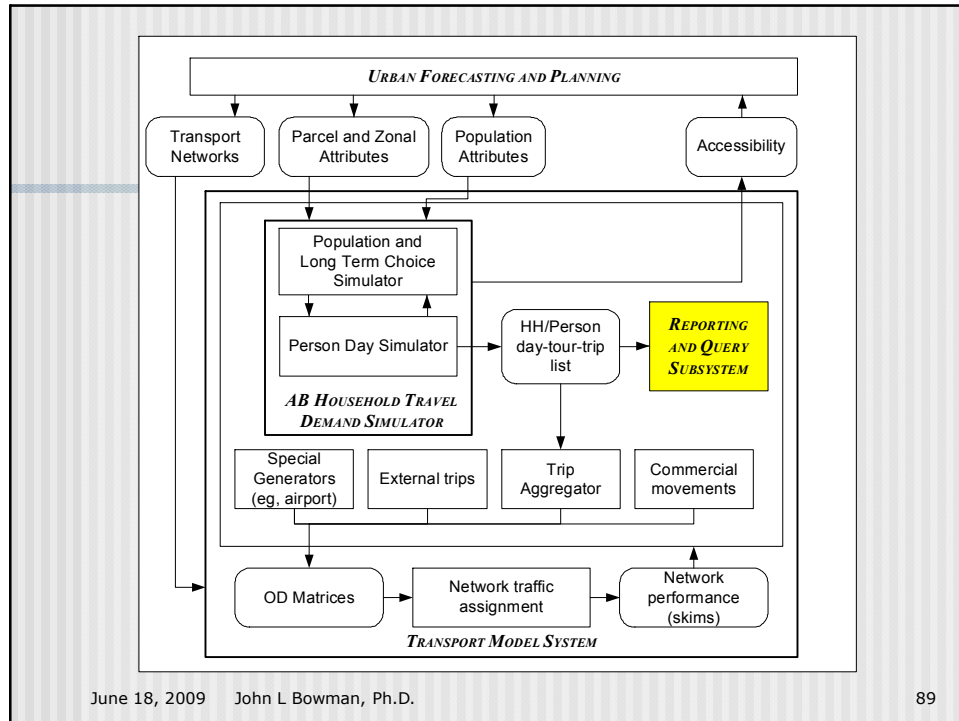
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Build AB Output Query System

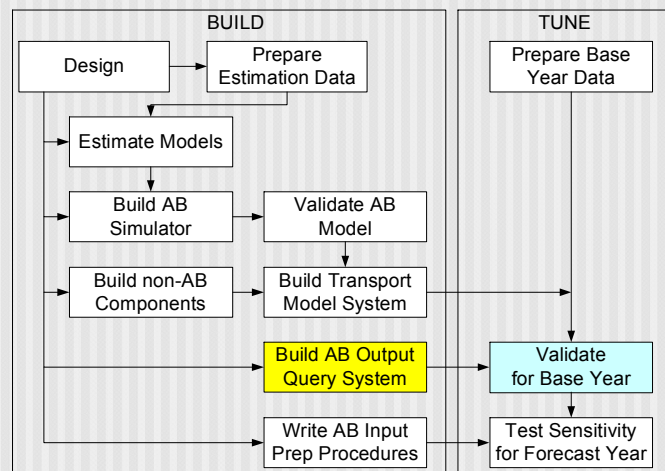


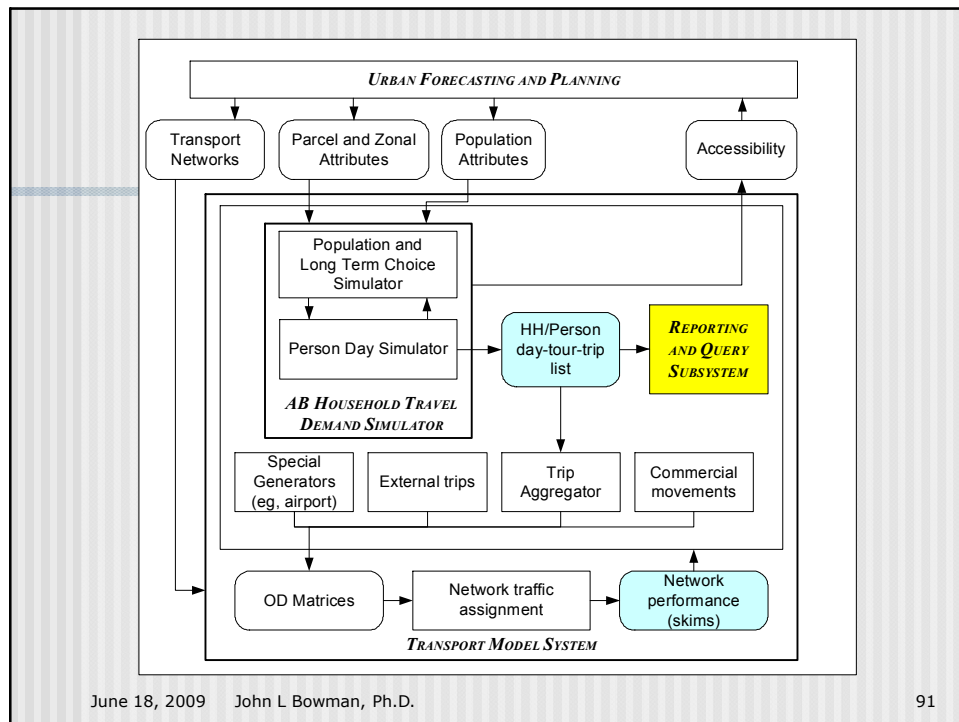
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Build AB Output Query System

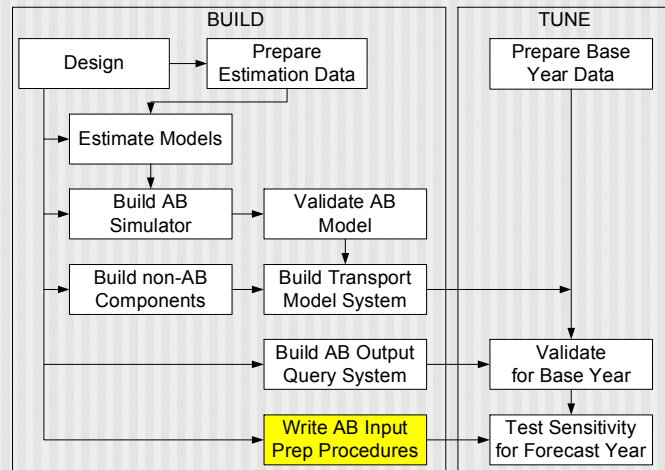




Build AB Output Query System

- Aggregate the AB trip lists as needed
 - Customary reports
 - Queries by chosen population segments
 - Merge with GIS for visual outputs

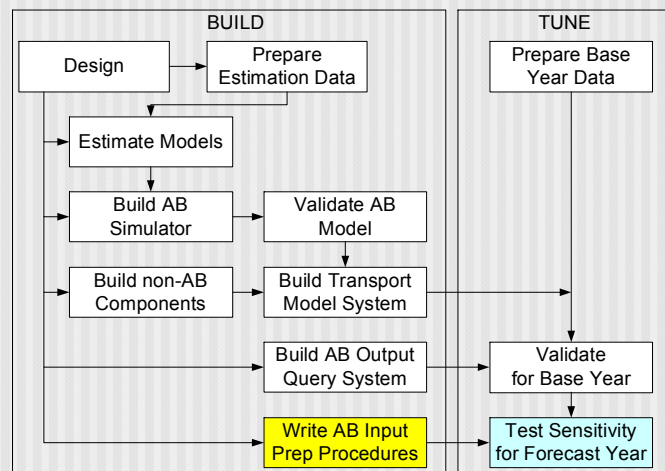
Write AB Input Prep Procedures



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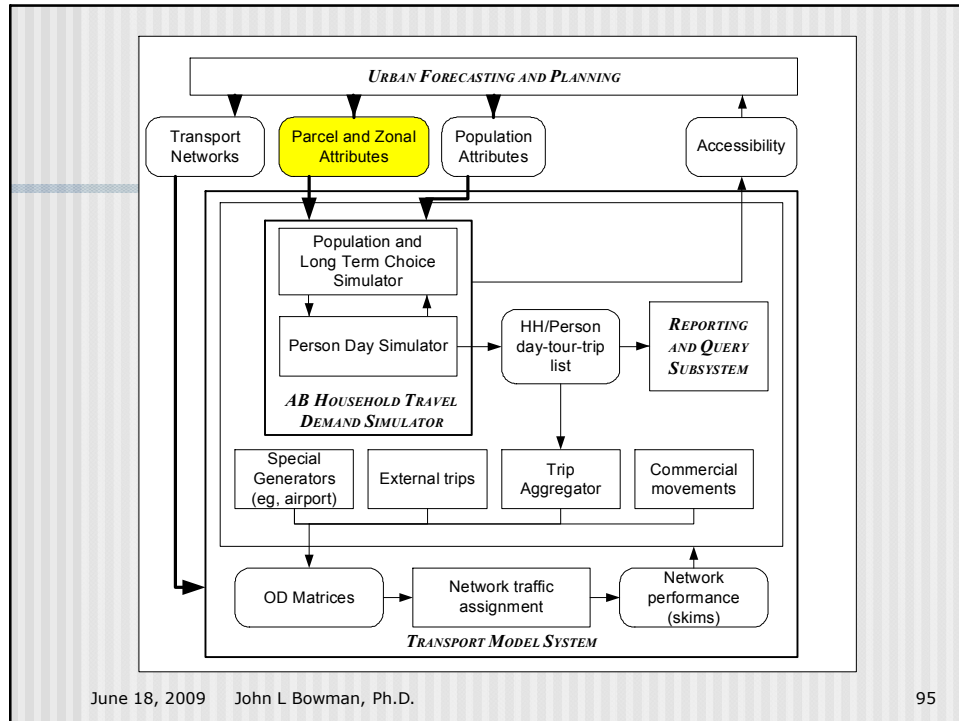
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Write AB Input Prep Procedures

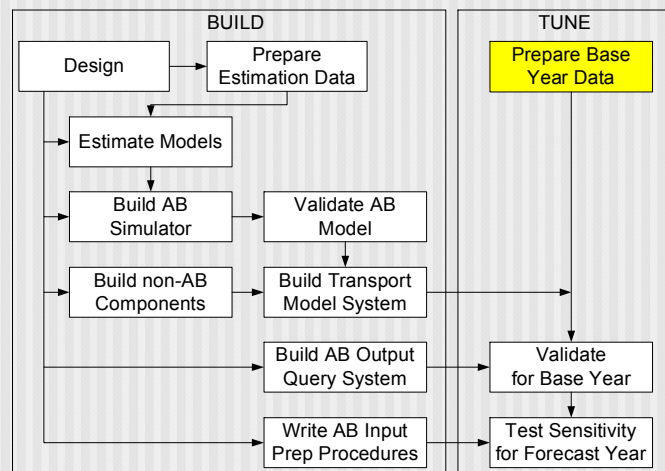


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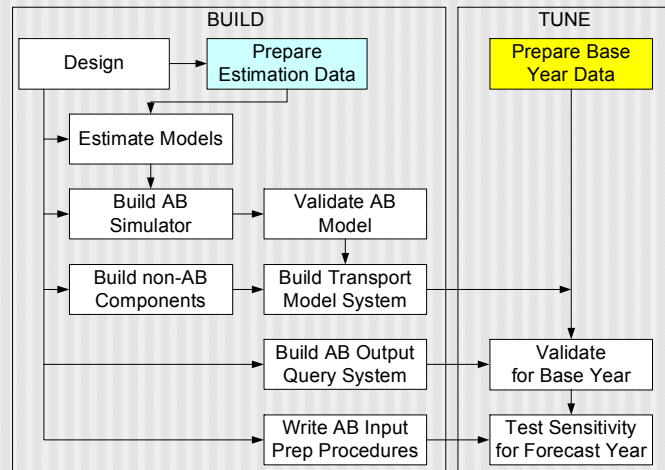
94



Prepare Base Year Data

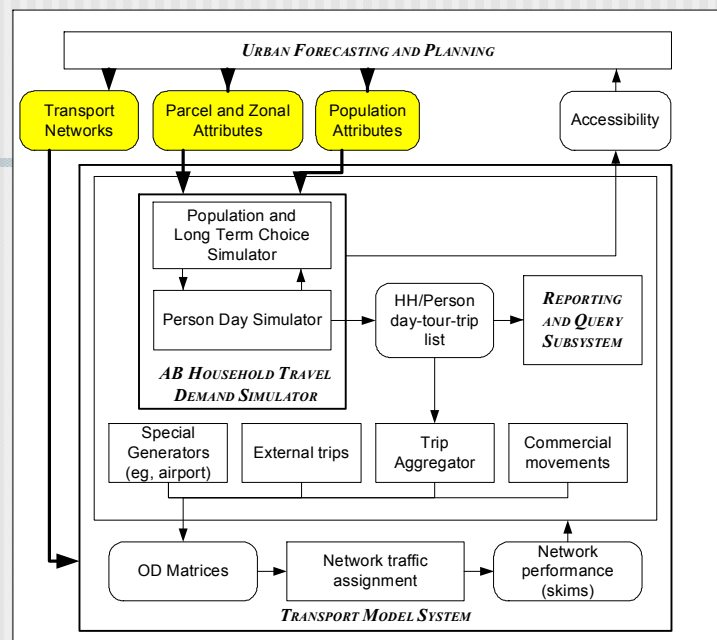


Prepare Base Year Data



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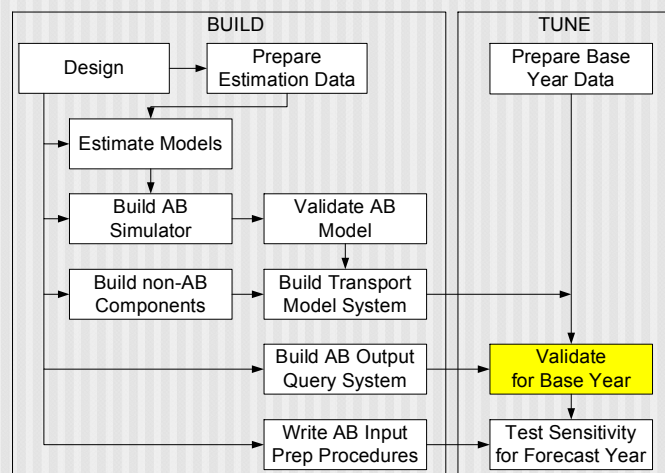
Prepare Base Year Data

- AB Input data
- Validation data (by time of day)
 - employment and school enrollment
 - work and school trip lengths
 - vehicle availability
 - transit counts
 - screenline counts

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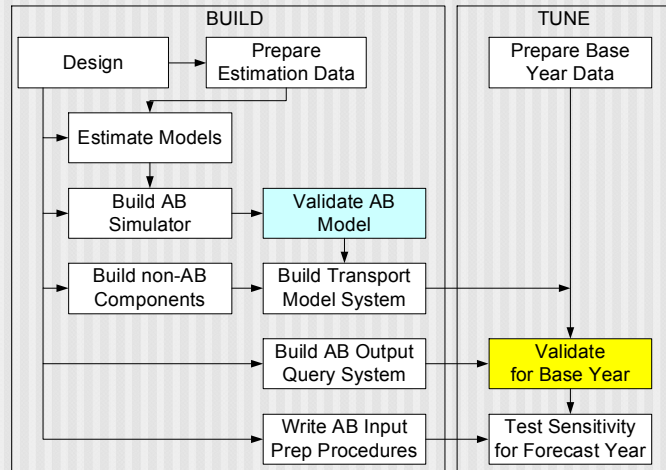
Validate for Base Year



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Validate for Base Year



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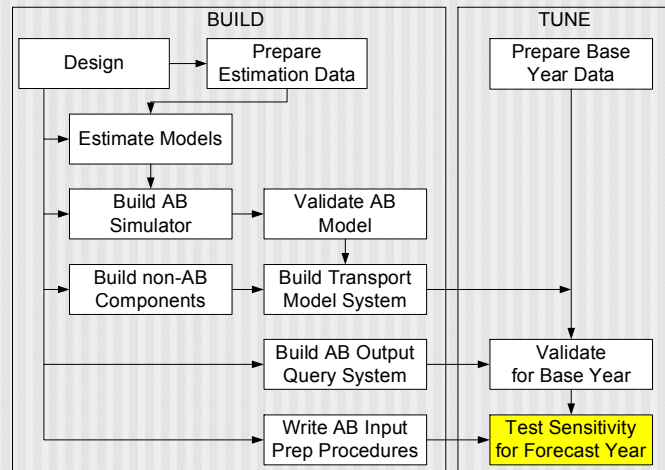
Validate for Base Year

- Much like trip-based model validation
 - Run model system on base year
 - Compare to validation data
- By time of day
- May require
 - calibration constants
 - Adjustment of models

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Test Sensitivity for Forecast Year



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Test Sensitivity for Forecast Year

- Test on scenarios of interest
 - Generate validation statistics
 - Check elasticities
- May require enhancement of models
- Train users
- Familiarize clients

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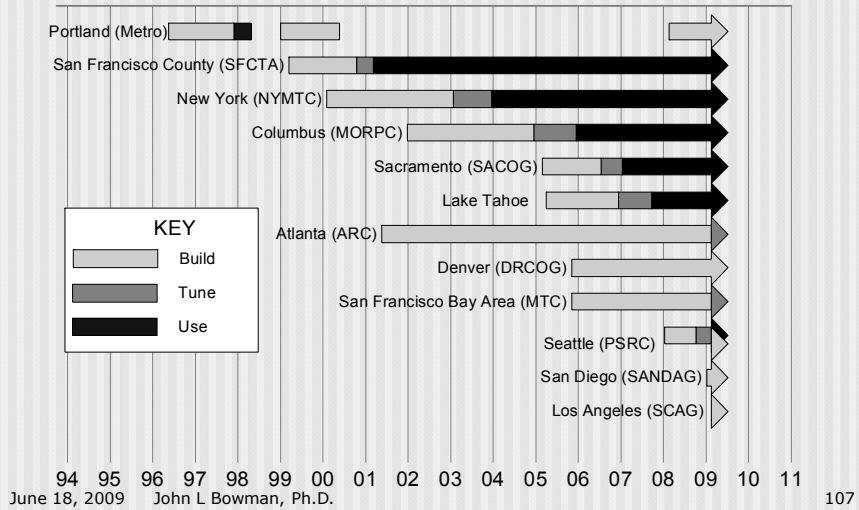
Outline

- Activity-Based (AB) Model System
- Development Tasks
- **Basic Build Approaches**
- Development Roles
- Management Keys to Success
- Postscript—A Few Suggestions

Basic Build Approaches

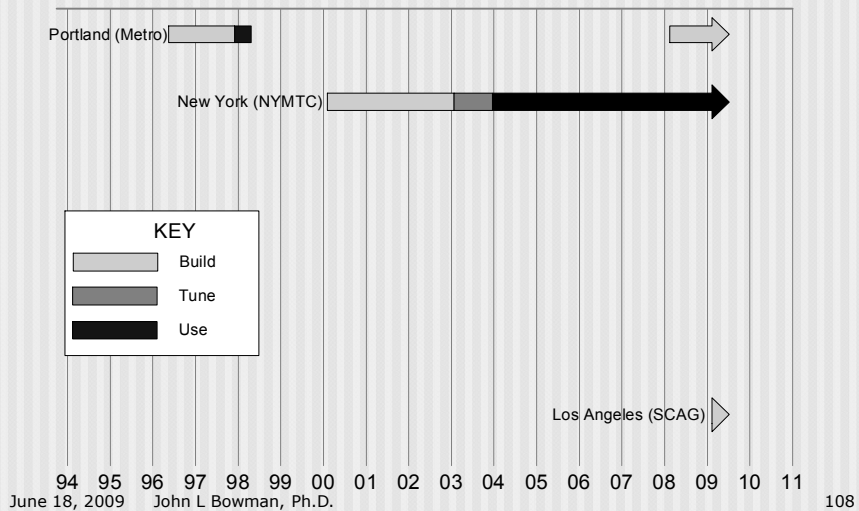
- Invent
- Adapt
- Adopt

U.S. Projects



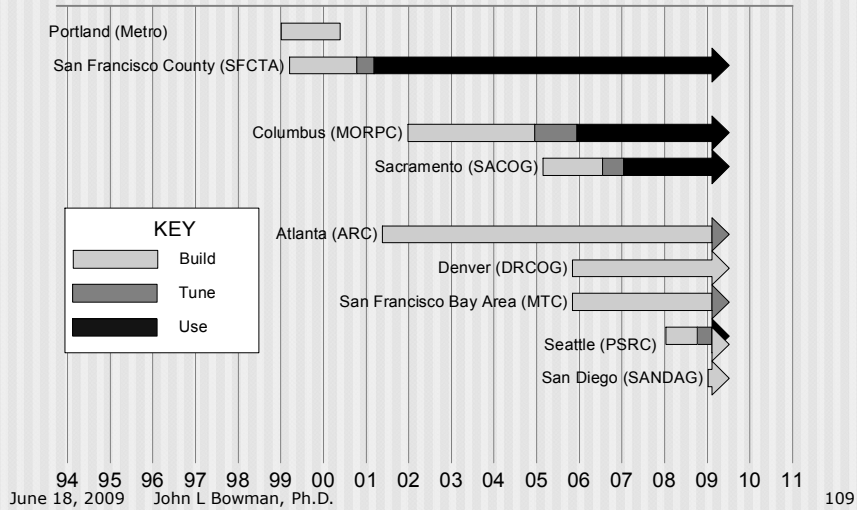
107

Invent



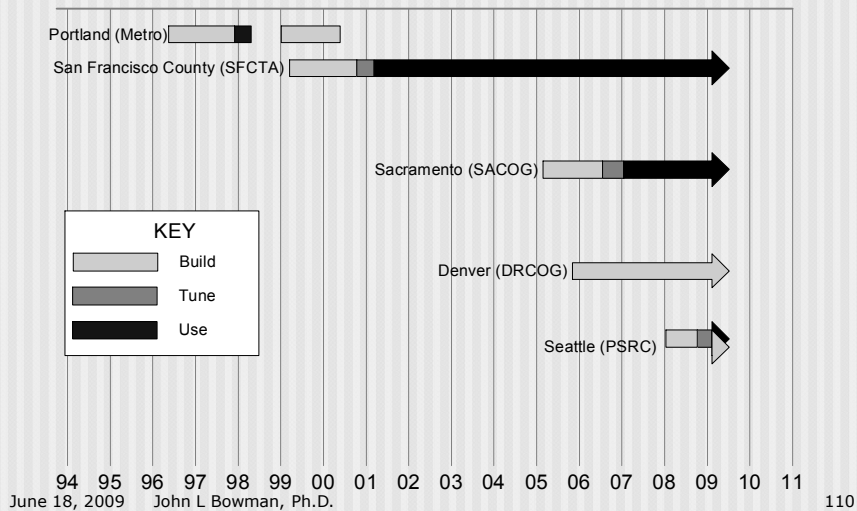
108

Adapt



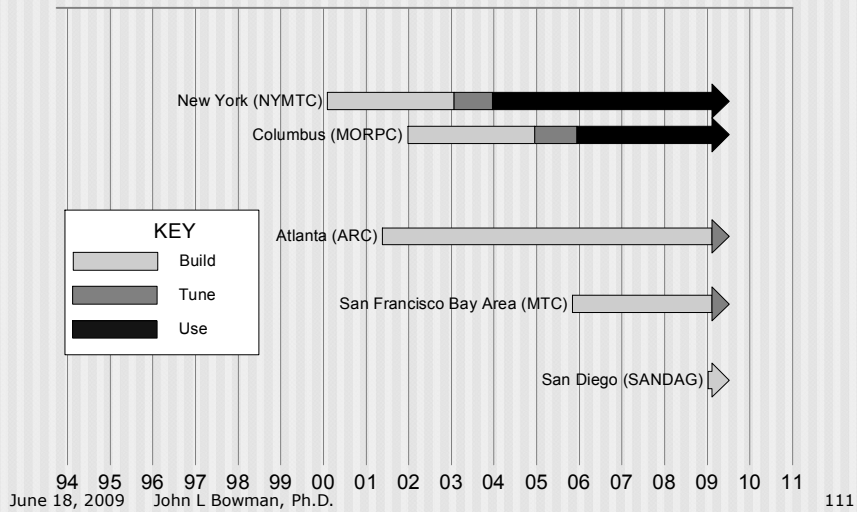
109

Adapt Metro

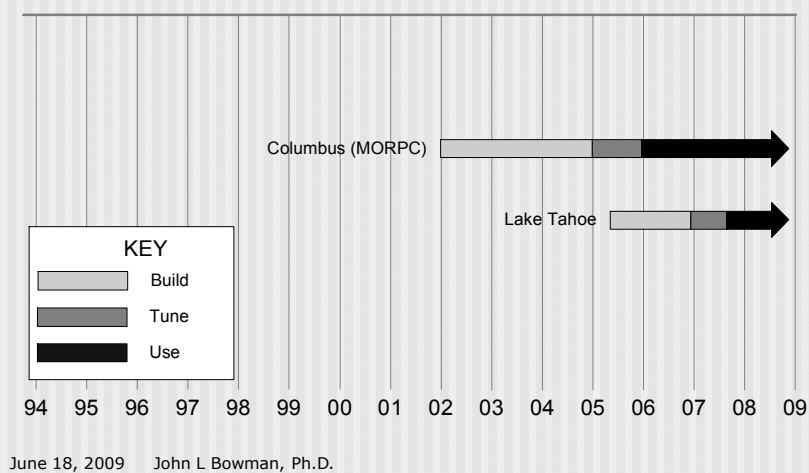


110

Adapt NYMTC

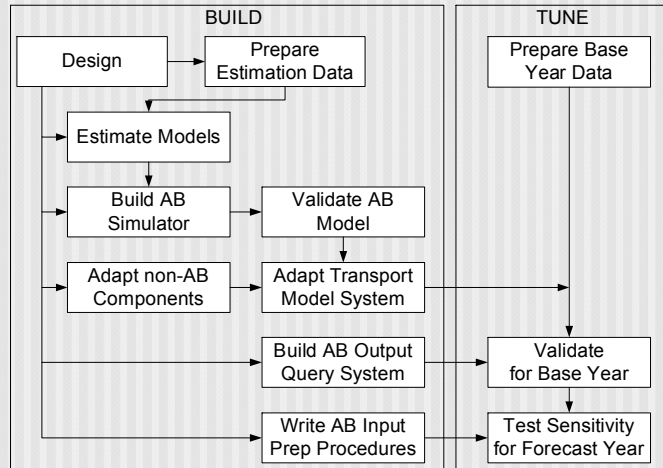


Adopt MORPC



Basic Build Approaches

Invent

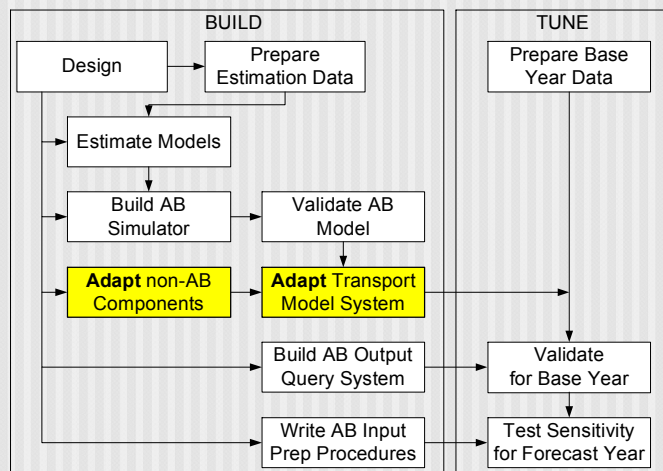


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Basic Build Approaches

Invent

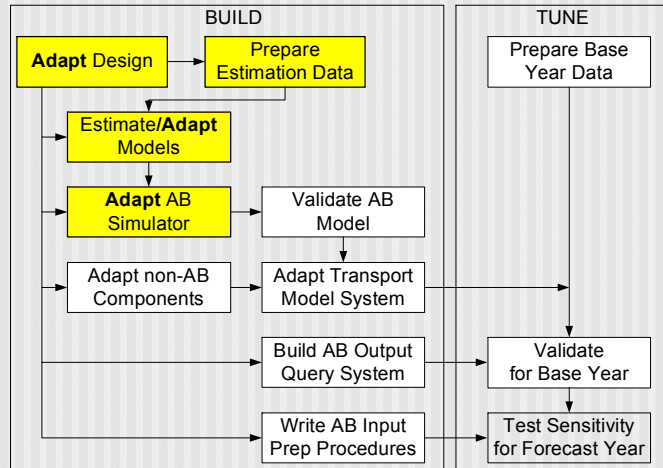


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Basic Build Approaches

Adapt

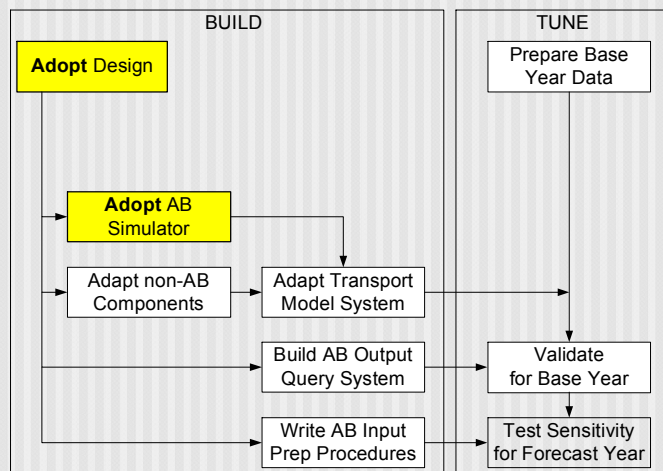


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Basic Build Approaches

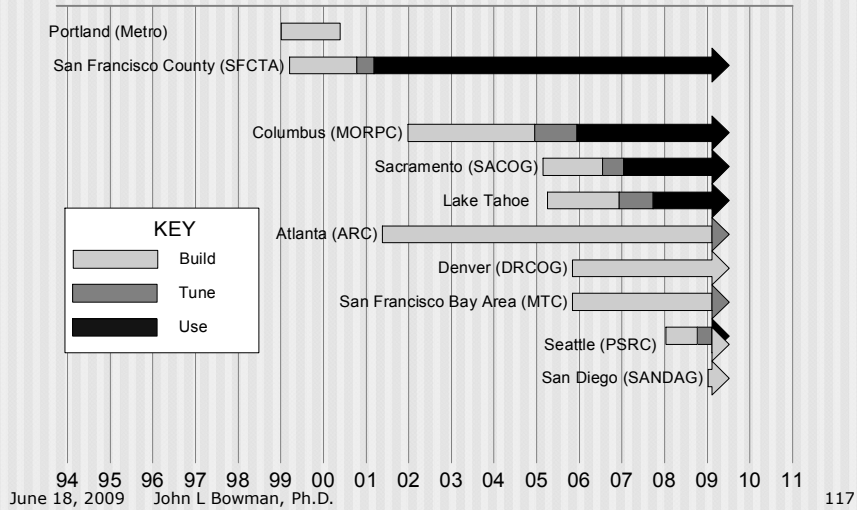
Adopt



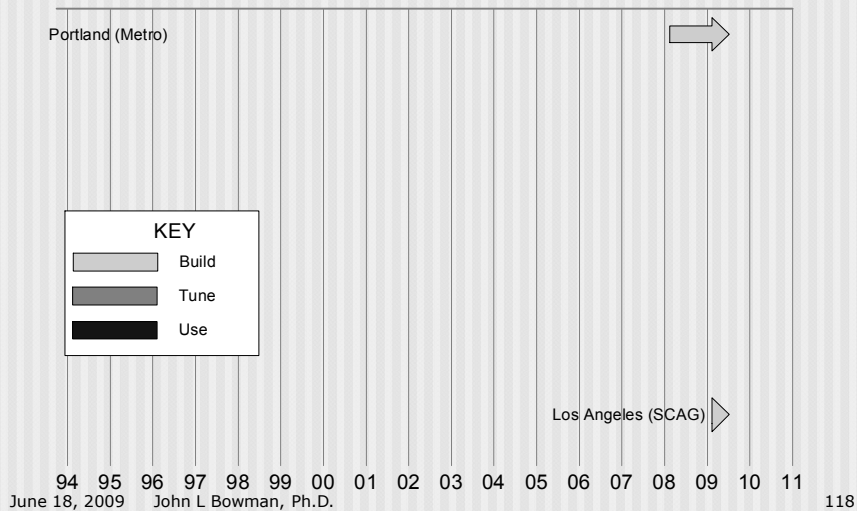
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Adaptations and Adoptions



Metro and SCAG: The Latest Inventions



Outline

- Activity-Based (AB) Model System
- Development Tasks
- Basic Build Approaches
- Development Roles
- Management Keys to Success
- Postscript—A Few Suggestions

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Development Roles

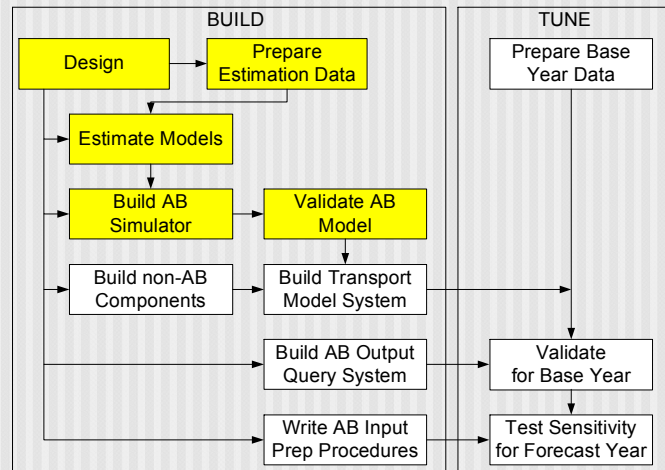
- AB Developer
- Trip-Based Model Expert
- GIS/DB/GUI Expert(s)
- Application Expert

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Development Roles

AB Developer

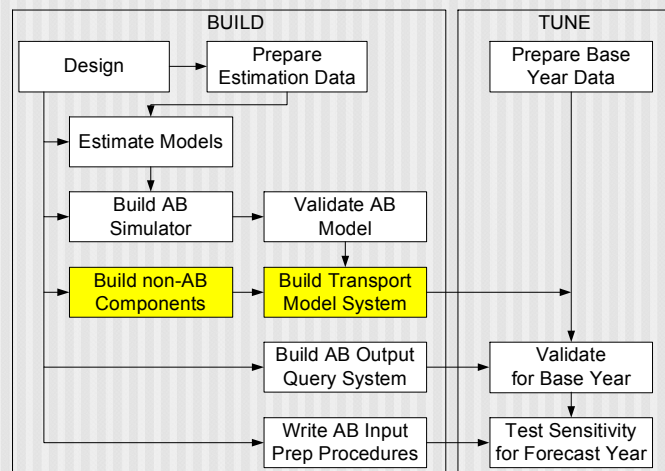


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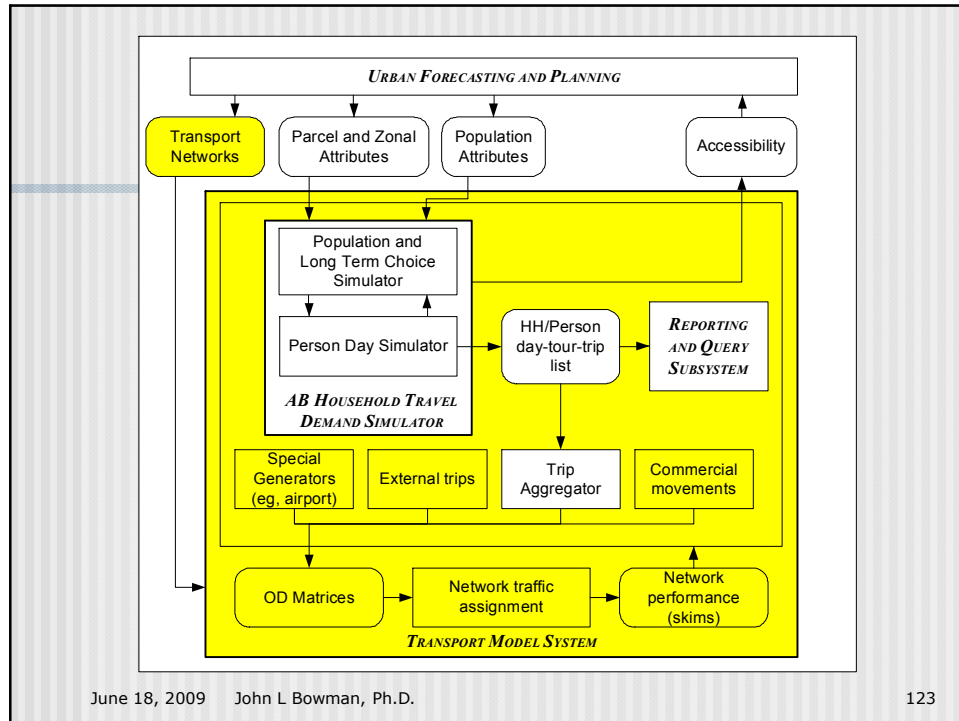
Development Roles

Trip-based Model Expert



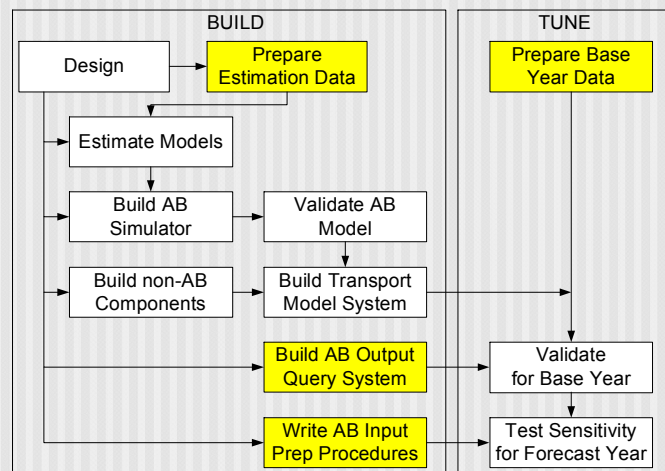
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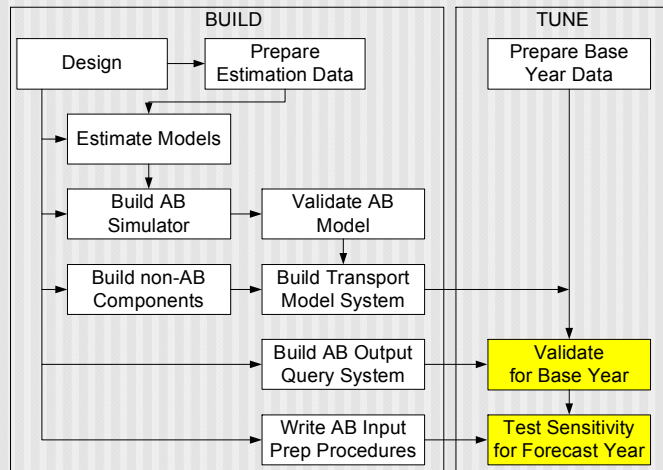
Development Roles

GIS/DB/GUI Expert(s)



Development Roles

Application Expert



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Consultant Role for All Models Now In Use

- AB developer
 - design
 - survey data prep
 - model estimation
 - AB software
- Other roles as needed
- Involvement after implementation

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DRCOG: Agency is sharing AB Developer Role

- AB developer
 - design—**assist**
 - model estimation—**estimate a few**
 - survey data prep—**augment**
 - AB software—**principal developer**

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Primary Definition of Success

- Model system got fully **implemented**
- Model was implemented consistently with a **sound** design
- Model continues to be **used** for its intended purpose

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Additional Aspects of Success

- Cost effective development
- Timely development
- Useful innovation
- Provides a foundation for ongoing enhancements

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Management Keys to Success

- A sound design
- Capable innovative developers
- Sustained sponsorship

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Keys to Success 1. A Sound Design

- Workable framework
- Completed up front
- Comprehensive and Integrated
- Implemented consistently

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Workable Design Framework

- Example: Metro started with successful MIT prototype
- What it gives
 - Soundness
 - Vision
 - Confidence
 - Something to build upon

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Keys to Success

1. A Sound Design

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- Completed up front
- Comprehensive and Integrated
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Management Keys to Success

- A sound design
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Keys to Success 2. Capable Innovative Developers

- AB Developer
- Trip-Based Model Expert
- GIS/DB/GUI Expert(s)
- Application Expert

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Keys to Success

2. Capable Innovative Developers

- What it gives
 - Technical soundness
 - Innovation
 - Usability and usefulness
 - Follow through

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Keys to Success

2. Capable Innovative Developers

- What it gives
 - Technical soundness
 - Innovation
 - Usability and usefulness
 - Follow through

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Keys to Success

2. Capable Innovative Developers

- What it gives
 - Technical soundness
 - Innovation
 - Usability and usefulness
 - Follow through

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Keys to Success

2. Capable Innovative Developers

- What it gives
 - Technical soundness
 - Innovation
 - Usability and usefulness
 - Follow through

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Management Keys to Success

- A sound design
- Capable innovative developers
- Sustained sponsorship

Keys to Success 3. Sustained Sponsorship

- Gives: stream of funds
- Requires:
 - Sponsor motivation
 - Instigating Advocate
 - Internal Champion

Keys to Success

3. Sustained Sponsorship

- Gives: stream of funds
- Requires:
 - Sponsor motivation
 - Instigating Advocate
 - Internal Champion

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Keys to Success

3. Sustained Sponsorship

- Gives: stream of funds
- Requires:
 - Sponsor motivation
 - Instigating Advocate
 - Internal Champion

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Keys to Success

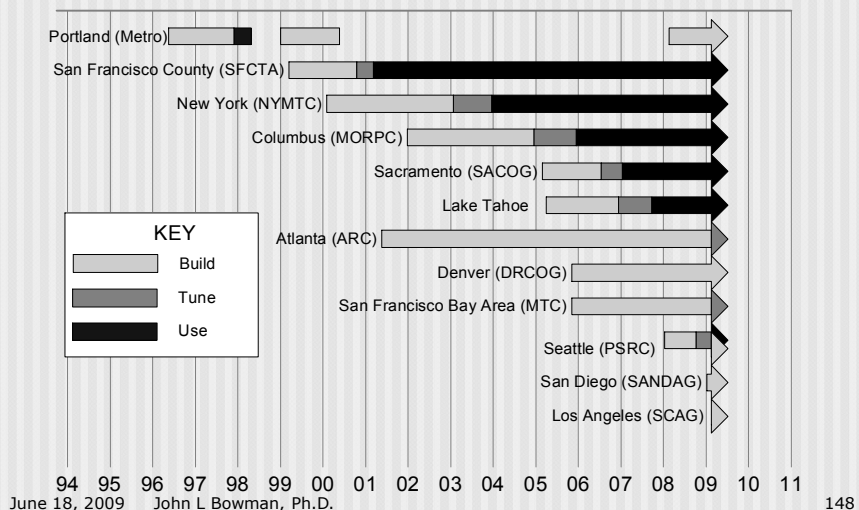
3. Sustained Sponsorship

- Gives: stream of funds
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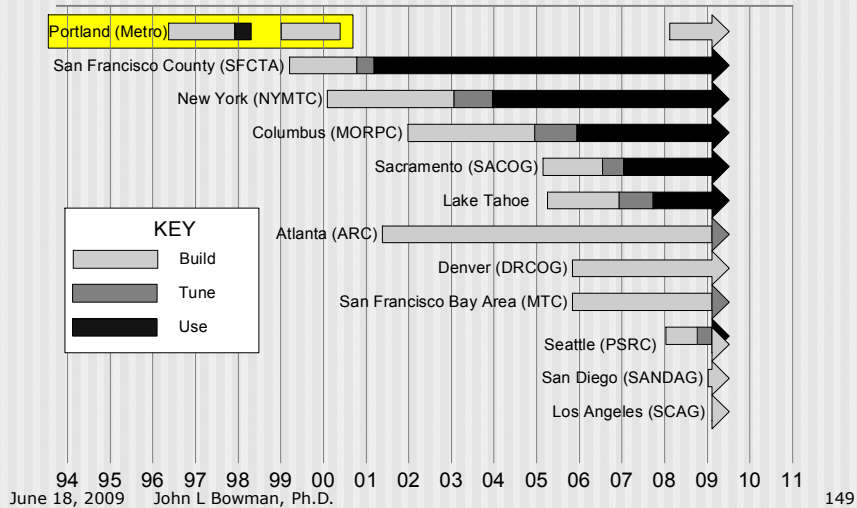
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Sustained Sponsorship Counter-examples



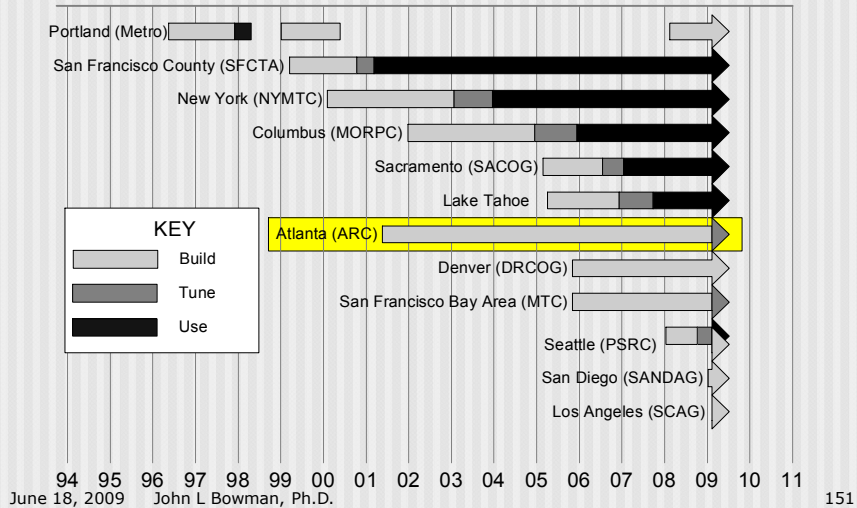
Why didn't Metro keep using their model?



Why didn't Metro keep using their model?

- Lost Sponsorship
 - MPO struggling financially
 - Federal funds for TranSIMS
 - No money for calibration & validation

Why is it taking ARC so long?



Why is it taking ARC so long?

- Sponsorship
 - ARC chose to invest at a slow rate
 - Expanded region from 13 to 20 counties
 - Commitment to implement the models didn't occur until early 2008

Management Keys to Success

- A sound design
- Capable innovative developers
- **Sustained sponsorship**

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Outline

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A Few Suggestions

1. Adapt

A Few Suggestions

1. Adapt
2. Don't wait on HH survey data

A Few Suggestions

1. Adapt
2. Don't wait on HH survey data
3. Seriously consider parcel data

A Few Suggestions

1. Adapt
2. Don't wait on HH survey data
3. Seriously consider parcel data
4. Innovate with care

A Few Suggestions

1. Adapt
2. Don't wait on HH survey data
3. Seriously consider parcel data
4. Innovate with care
5. Implement promptly, then enhance

Outline

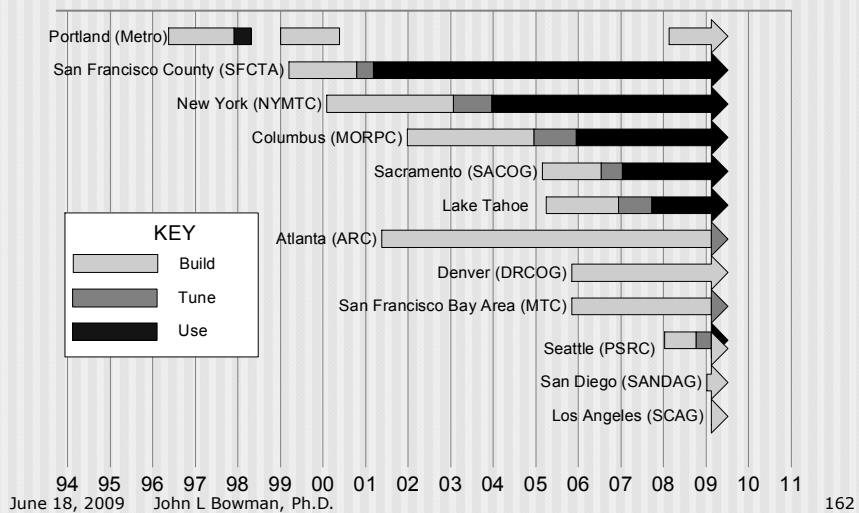
- Activity-Based (AB) Model System
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- Basic Build Approaches
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- Management Keys to Success
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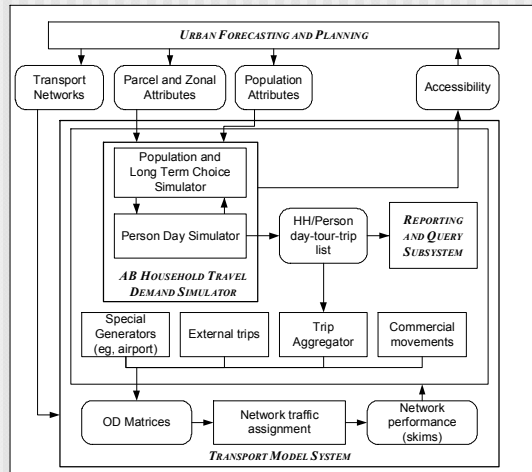
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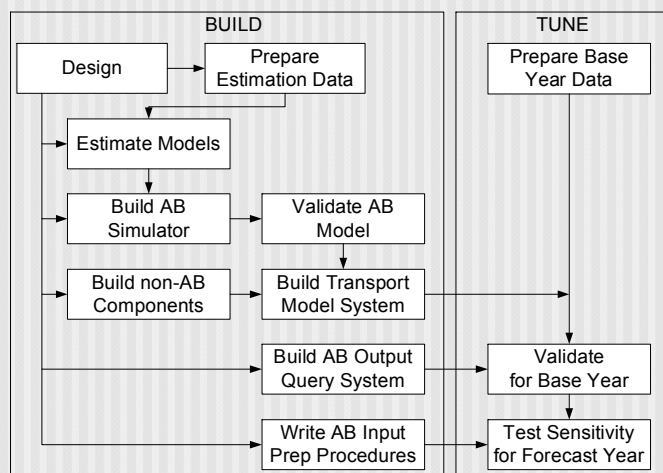
Activity-Based Model System



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The Tasks



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Basic Build Approaches

- Invent
- Adapt
- Adopt

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Development Roles

- AB Developer
- Trip-Based Model Expert
- GIS/DB/GUI Expert(s)
- Application Expert

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Management Keys to Success

- A sound design
- Capable innovative developers
- **Sustained sponsorship**

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A Few Suggestions

1. Adapt
2. Don't wait on HH survey data
3. Seriously consider parcel data
4. Innovate with care
5. Implement promptly, then enhance

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